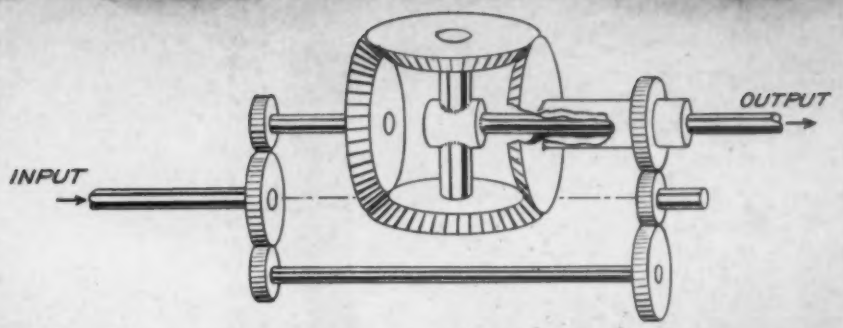
NOVEMBER 30, 1959

Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT



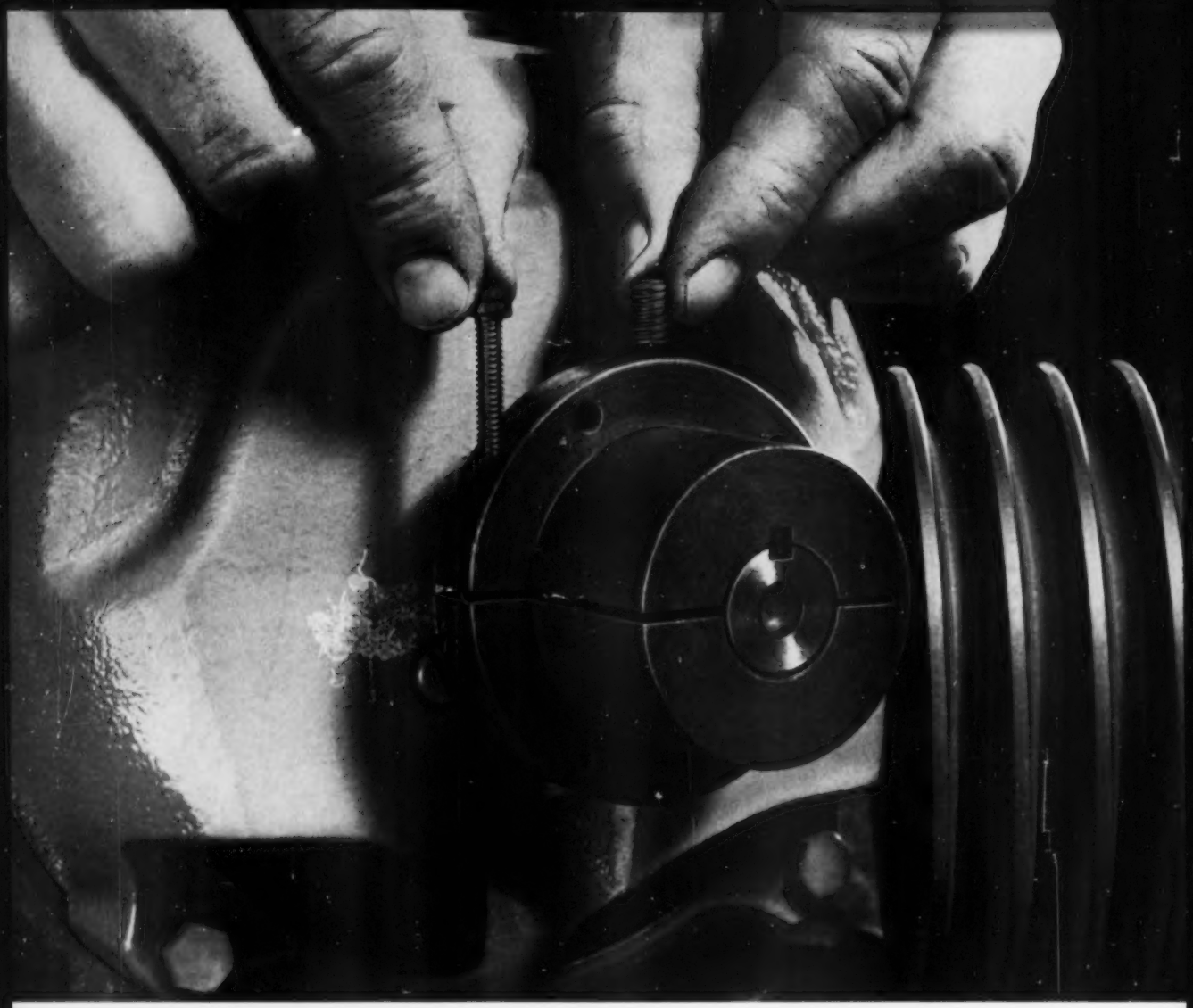
Output shaft turns:

(a) Faster than input, same direction
(b) Slower than input, same direction
(c) Same speed as input, same direction
(d) Same speed as input, opposite direction
(e) Faster than input, opposite direction
(f) Slower than input, opposite direction

Answer . . . see page 4

HOW GOOD ARE ENGINEERING APTITUDE TESTS?

. . . see page 32



Announcing Worthington QD Sheaves with the

GOLDEN SCREWS

To demonstrate to you that the exclusive two-screw design is practically worth its weight in gold, all Worthington QD (Quick Detachable) sheaves now have two golden screws.

The clamp screw simplifies installation and assures permanent alignment. You can install QD sheaves one part at a time. No heavy rim and hub combination to delicately inch into place. You just slide the hub on the shaft and permanently lock it in position with the clamp screw. Then you slide the sheave rim into position on the hub. This job is simplified because you engage the large end of the sheave with the small end of the hub. To change speed you simply install another sheave on the hub which remains anchored to the shaft by the clamp screw.

The set screw prevents "key drift." It locks the key securely in place, avoiding the danger of the key drifting off and becoming a safety hazard. This feature is appreciated by plant operators who first brought this potential danger to Worthington's attention.

You tighten the set screw without distorting the hub. The clamp screw allows you to locate the hub on the shaft. The locked hub then permits you to tighten set screw on key without distortion.

You can get Worthington QD sheaves anywhere in the U.S. More than 350 distributors carry Worthington sheaves and Worthington-Goodyear Green Seal V-belts. For your copy of a 100-page Multi-V-Drive Manual on how to select the right sheave and V-belt write to Worthington Corporation, Section 79-15, Oil City, Pennsylvania. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON

coming
next week

a
PRODUCT
ENGINEERING
Special Report

how to choose the right

ELECTRICAL CONNECTION

For the first time, direct comparisons of all electrical connection methods—permanent and separable.

To give you this report the author compiled and analyzed important test and field data from all known sources. He has reviewed the advantages and disadvantages of each type and set up a 0 to 10 scale of applicability of each to the anticipated environment.

Here's a table condensing thousands of hours of test and years of experience—plus guidance on how to spot trouble on the way, the right and wrong methods of manufacture.

Don't miss this 11-page Special Report in the DESIGN issue for December 7.

←CIRCLE 76 ON READER SERVICE CARD

and
in addition

the DESIGN issue

for December 7
will feature:

- **Overload protection for geared devices**
  What kind of torque-limiting device and where to put it to protect machine and motor.

- **What size access openings?**
  These minimum dimensions will accommodate 95% of all people.

- **Americanizing a British design**
  What to do about dimensions, tolerances, manufacturing techniques and shop practices.

- **7 Applications for the constant-force spring**
  In a magazine feed, one-way brake, motion transfer device, mechanical servo and others.

- **Soldered aluminum joints**
  How the dozens of available solders are used and how they will act in time.

- **5 Important gasket materials**
  Quick reference facts to aid selection among paste, felt, cork, rubber, and metallic seals.

Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

R RESEARCH and D DEVELOPMENT news issue

November 30, 1959 Vol. 30 No. 49

FEATURED:

DEPARTMENTS:

SIDELIGHTS 4
HORIZONS 19
SIGNIFICANT COMPONENTS 37
NEW LITERATURE 41
ADVERTISERS' INDEX 41
FYI PERSONAL 42
WHY NOT R & D? 43
PUBLISHER'S POSTSCRIPT 44

STEEL STRIKE PUSHES CAPITAL SPENDING. McGraw-Hill survey shows $37 billion planned for 1960 25

TRENDS IN APPEARANCE DESIGN. Some of the newer European car designs, a drill-pointer 30

ENGINEERING APTITUDE TESTS. A survey of the types, how they are used, and how reliable the test scores are 32

FIELDS OF INTEREST:

MATERIALS:

High-temperature aluminum alloys ready for evaluation 7
Refractory made from rice hulls withstands 3000 F 9
New materials for electronics: purity to four nines or better 13

PROCESSES:

Wood that stops neutrons has been developed 9
Synthesize elements for power sources says AEC 12
Coating process for corrosion protection in atomic patent 13
Improved chrome plate makes for better die castings 27

ELECTRICAL:

Microminiature lamps are ¼ in. long by 0.045 in. dia 7
Amplified brain waves can be used to control equipment 9
New British motor for vibrating devices 9
Thermocouple developments to be announced by Navy 11

DESIGN:

New oil mist system can handle heavy lubricants 7
Fuel line sealants will work at 700 F 7

TEST:

How much dirt? Device counts dust specks automatically 12
Titanium creep stopped by accelerated aging process 13
Rocket-ramjet engine combinations tested 26

GOVERNMENT:

Air Force policy to shift away from weapon-system concept 11
Budget talk indicates hold the line on defense spending 11

Product Engineering ..... SIDELIGHTS

R and D RESEARCH news issue DEVELOPMENT

STANLEY J ALLING *publisher*

ELMER J TANGERMAN *editor*

ROBERT W CARSON *managing editor*
ROBERT E ABBOTT *senior associate editor*
RICHARD M KOFF *senior associate editor*

JOHN KOLB *associate editor*
NICHOLAS CHIRONIS *associate editor*
FORD R PARK *associate editor*
ROBERT S PRENTISS *associate editor*
ANNESTA R GARDNER *associate editor*
WILLIAM GILMAN *associate editor*
FRANKLIN D YEAPLE *associate editor*
JOSEPH J KELLEHER *associate editor*
DOUGLAS C GREENWOOD *associate editor*

BENEDICT A LEERBURGER, JR *assistant editor*
PHYLLIS B SWEED *assistant editor*
DORA K MERRIS *assistant editor*
HERBERT KEE *assistant editor*
CHARLES J LYNCH *assistant editor*

FELIX GIORDANO *Detroit*
JACK MEYER *Los Angeles*
SETH PAYNE *Washington*

RICHARD E ROOMAN *art director*
E G LOADER *associate art director*
ANGELA M GIACIN *assistant*

NORMA J VAN NESS *production supervisor*
LILLIAN M WITHAM *assistant*

ROBERT E BRUCKNER *consulting editor*

DEXTER KEEZER *director, economics dept*

JOHN WILHELM *director News Bureaus*
MARGARET RALSTON *assistant*

GEORGE B BRYANT, JR *Washington*
DONALD MacDONALD *Detroit*
ARTHUR ZIMMERMAN *Cleveland*
STEWART W RAMSEY *Chicago*
JENNESS KEENE *San Francisco*
KEMP ANDERSON *Los Angeles*
RAY BLOOMBERG *Seattle*
B E BARNES *Atlanta*
MARVIN REID *Dallas*
JOHN SHINN *London*
JOHN TUNSTALL *London*
ARTHUR ERIKSON *Paris*
GENE DI RAIMONDO *Milan*
RAYMOND SHAH *Zurich*
CURT AGREN *Stockholm*
ROBERT GIBSON *Moscow*
MORRIE HELITZER *Bonn*
SILKE BRUECKLER *Bonn*
JIM MORRISON *Bonn*
SOL SANDERS *Tokyo*
JOHN YAMAGUCHI *Tokyo*

PHILIP G WEATHERBY *advertising sales manager*
P F PRITCHARD *manager, market research*
ROBERT C MATTOON *circulation manager*
C C KANE *reader service manager*
RUSSELL T DOUGLAS *business manager*

● **Personnel managers really like psychological tests** (p 32). Perhaps this affection is not quite critical enough—at least Ross Stagner of Wayne State Univ thought so, and ran an interesting experiment to prove it. At a conference of personnel managers he gave his audience a standard personality test. He then prepared a fake personality analysis which included statements like: you have a tendency to be critical of yourself; disciplined and self-controlled outside, you tend to be worrisome and insecure inside; you prefer a certain amount of change and variety and become dissatisfied when hemmed in by restrictions and limitations. These and similar generalities were circled on the score sheet and the individual's name was written in at the top. The sheets were handed out individually, but every man in the group had exactly the same personality "analysis." He then asked the group how accurate they thought the test was. In a 5-step scale (amazingly accurate; rather good; about half and half; more wrong than right; almost entirely wrong), 50% felt the test was "amazingly accurate," 40% felt it was "rather good," 10% "about half and half." Compare these gullibility figures with the results from a similar fake analysis of a group of college students (who voted 25% and 37% in the first two categories) and you begin to speculate about your next job interview.

● **TV advertisers** are reported flirting with subliminal messages again—this time aimed at your dog. The trick is to transmit a supersonic barking accompaniment to the picture of a can of dogfood. Your dog barks in answer and you dash out to satisfy his love of the label. Won't work on our set. That speaker would tear itself into neurotic pieces over anything beyond 8000 cps.

● **Answers to the test problems in this issue:** Don't cheat—do the problems first! Cover problem (e). Page 33: Mechanical Comprehension—X (A), Y (D); Engineering Analogies— 1 (b), 2 (d), 3 (b); Verbal Reasoning —1 (true), 2 (false), 3 (unknown), 4 (false), 5 (unknown).

ABP November 30, 1959

PRODUCT ENGINEERING
A McGRAW-HILL PUBLICATION

Vol. 30, No. 49 ABC

PRODUCT ENGINEERING is published weekly—with an additional Design Digest Issue in Mid-September, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Officers of the Publication Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice-President; John R. Callaham, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and consultants engaged in the design of machinery and other engineered products. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

United States subscription rates for individuals in the field of the publication, $5.00 per year, single copies 50 cents; Canadian subscriptions $7 per year; foreign $25 per year, payable in advance. Second-class postage paid at Albany, N. Y., U.S.A. ©Copyrighted 1959 McGraw-Hill Publishing Company, Inc., all rights reserved.

UNCONDITIONAL GUARANTEE. If Product Engineering's editorial service becomes unsatisfactory for any reason, paid-up subscribers may cancel their subscription on request to our New York office, and the proportionate subscription price of any unmailed copies will be refunded.

PRODUCT ENGINEERING articles are indexed in both the **Applied Science and Technology Index** and the **Engineering Index.** PRODUCT ENGINEERING publishes its own semi-annual index. Copies are obtainable on request to the Editor.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address giving old as well as new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

Postmaster: Please send form 3579 to PRODUCT ENGINEERING, 330 W. 42nd St., New York 36.

THIS IS GLASS

A BULLETIN OF PRACTICAL NEW IDEAS FROM CORNING

NEW! A MIRROR THAT MAKES HEAT TO BEAT SLEET

You're jockeying a big trailer-truck along a winding road in New England. It's winter and you run into a real storm—a mixture of snow, rain, sleet. You flip a switch and . . .

Your outside rear-view mirror is *clear* in a matter of minutes. From a heavy coating of ice to *all* clear is only a matter of five minutes, even at −20°F.

The mirror, as you might guess, isn't just ordinary glass. It's one of Corning's PYREX brand glasses, and on its surface is an electrically conductive coating that's permanently fired in.

This coating (a metallic oxide) is what turns your mirror into a *heating* element when a current is applied. The heat melts ice and snow, prevents fog or drizzle from condensing on the surface.

If you use EC (electrical-conducting) glass for self-defrosting mirrors you get a bonus, since the coating also provides a non-glare surface.

But don't go away just because you gave up dreaming about driving a truck-and-trailer years ago. This PYREX® electrical-conducting glass comes in a wide choice of applications.

For example, there are some enterprising people who build radiant heaters, both portable and permanent, around such glass panels.

Comfort, safety, and convenience are the big selling points. Comfort because a panel of EC glass is an area *heat* source putting out long waves. Safety because there are no exposed wires or moving parts. Convenience since you have no burning, no need to do extensive remodeling in order to install it.

These same reasons have made PYREX brand radiant heating units attractive to industry—for heating, drying, curing, baking.

And, if you turn a panel of this glass *around*, it becomes an infrared reflector you can see through—blocking heat but still passing about 75% of the visible light.

Facts? Ask for PE-34, a 4-page data sheet, and/or PE-60, all about industrial heating units. Please use the coupon.

HOW NOT TO FOUL UP THE WORKS

It's really very simple: If you're using spun insulation in electric motors, you have to keep the stuff from falling into the moving parts and fouling up the works.

Two things to keep in mind when selecting a material for this application: (1) It has to stand up to quite a bit of heat. (2) It *can't* be a conductor.

Some materials that are good insulators can't take the heat. Others function well at high temperatures but are not insulators.

Glass solves both problems. So, people who make electric motors build them with wedges made from PYREX brand glass No. 7740. (We supply the glass in rod form.)

This particular PYREX brand glass offers a number of useful characteristics. It is corrosion resistant and has a linear coefficient of expansion of 32.5 x 10^{-7} in/in between 0° and 300°C. Dielectric properties at 1 Mc and 20°C. are as follows:

Power factor	.46
Dielectric constant	4.6
Loss Factor	2.1

Wedges made from glass rod support spun insulation in electric motors. Glass is non-conducting and able to stand high temperature without deforming.

You can get PYREX brand glass No. 7740 in a variety of forms—pressed ware, blown ware, plate, tubing, rod and panels.

Mechanical, thermal, electrical, and chemical properties of this glass and 27 others are spelled out in Bulletin B-83. Check the coupon for a copy.

PLUMBING FOR POSTERITY

An increasingly popular fixture in labs, hospitals, schools, chem plants, and photo-engraving shops is the glass drainline.

With good reason. Glass drainlines are fashioned from PYREX brand glass No. 7740.

This is the glass that ends your worries about corrosion. For example, if you were disposing of waste hot hydrochloric acid, your PYREX pipe would still be around at the end of 200 years.

And glass is smooth; very little chance for block-up in the pipe. If such does occur, however, you can spot the exact point and take corrective action, without having to take down the whole system.

In fact, almost anything made from PYREX brand glass No. 7740 will be around for quite a while because this glass is able to cope with thermal shock and physical knocks, too.

Available in many forms—tubing, rod, pipe, plate, and all kinds of shapes.

Fill in the gaps in your files with these basic references: PE-30, all about glass drainlines; IZ-1, design considerations in glass. Any or all, free. Use the coupon.

MORE ON PYROCERAM*

Developments in our new crystalline materials made from glass are treated at length in the third Pyroceram Progress Report. See coupon.

*Trade Mark

CORNING MEANS RESEARCH IN GLASS

CORNING GLASS WORKS 51 Crystal St., Corning, N. Y.

Please send me: ☐ PE-60, booklet on heating units; ☐ B-83, "Properties of Selected Commercial Glasses"; ☐ IZ-1 Design Manual; ☐ PE-30 Drainline Manual; ☐ Pyroceram Progress Report No. 3; ☐ PE-34, "Corning Flat Glasses."

Name ..... Title .....

Company .....

Street .....

City ..... Zone ..... State .....

FACTS ON **KEYSTONE** POWDER METALLURGY

Powder Metal Parts of STAINLESS and ALLOY STEELS

...too expensive if you don't need 'em —often the cheapest, if you do!

Like Stainless in any other form, your powdered stainless parts will cost more by the pound and do more by the piece. This is also the case with parts of high-strength alloy steel powders—the economies are properly determined solely by the application.

Fortunately, there's no mystery about whether you should or shouldn't use these outstanding materials for your special performance requirements. Our experience as the largest producer of powdered stainless parts is as intensive as our alloy steel and other metals background is broad. We have a wealth of cost and application data that will make crystal-clear your choice and the alternatives to consider.

We suggest that your first step in deciding on stainless, alloy or any other material for your projected part is to *consult Keystone*. We mold and sinter all the commercial metal powders, and we play no favorites!

Keystone
CARBON COMPANY
St. Marys, Pa.
POWDERED METAL PARTS DIVISION

DEVELOPMENTS TO WATCH...

American

High-temperature aluminum alloys . . .

. . . with "excellent mechanical properties in the 500 to 1000-F range," developed by Aluminum Co of America, are now ready for engineering evaluation.

These are powder-metallurgy alloys containing about 0.5 to 14% aluminum oxide in the matrix and need no heat treatment. Instead, they depend on dispersion hardening for their strength. This means they can be used in the as-fabricated condition. Furthermore, says Alcoa, they are not "time-sensitive." (They show substantially the same properties after 1000 hr at 700 F as they do after 1 hr

Test data are still being compiled on the four types being offered but the properties indicated for extruded sections are: room-temperature tensile strength, 51,000 psi; yield strength, 36,000 psi; and elongation, 14%. Flash-welded plate (¼ in.) shows a room-temperature tensile strength on the order of 36,000 psi, yield strength of 28,000 psi, and an elongation of 5.5%.

At 800 F, the corresponding figures for extrusions are 14,000, 11,000, and 23%; and for flash-welded plate, 11,900, 10,500, and 3.5%.

Information on these alloys may be obtained by writing to 1501 Alcoa Building, Pittsburgh 19.

Sealants that can be used at temperatures to 700 F . . .

. . . on fuel lines and in pressurized systems are being developed by Products Research Co, Los Angeles, under Wright Air Development Center contract. Best bets thus far: modified fluorinated rubbers and room-temperature-vulcanizing silicones. The former, PRC says, showed satisfactory resistance to JP-5 fuel at 450 F for 168 hr and 600 F for 10 hr.

PRC is also investigating radiation stability of such materials, and means for improvement. Here, too, modified fluorinated and silicone rubbers look most promising. Both materials appeared to be serviceable after exposure to gamma irradiation at 8.71×10^8 ergs/g. However, says PRC, "none of the compounds which were studied as antirads (inhibitors to reduce radiation sensitivity) were of any value in improving the radiation resistance of any of the sealant systems that were investigated."

Much heavier lubricants can be applied . . .

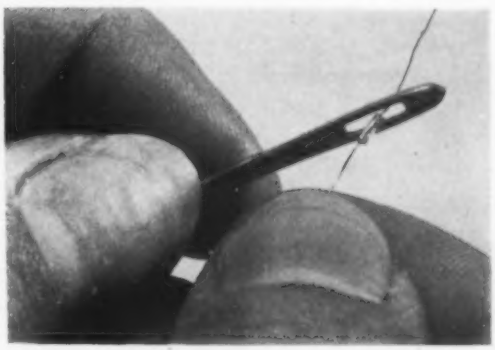
. . . to gears, shafts, and other working parts with a new system developed for oil mist application, says Alemite Div, Stewart-Warner Corp. In place of the usual heating and spraying devices, Alemite is using heated air to generate and apply the mist, and reports oils as heavy as 75,000 sec (Saybolt viscosimeter) can be handled, as compared to the previous 1000-sec oil limit. First application is to a big pinion gear which drives a radome ring gear; but Alemite expects a wide range of uses.

Microminiature lamps are now available for evaluation . . .

. . . These are the tiny incandescent bulbs developed by Diamond Ordnance Fuze Laboratories (*PE—July 13, p 9*) for use with transistorized circuits and in other applications where very small, long-lived lamps are needed. Sylvania Electric Products is to be the manufacturer, is already producing them in pilot quantities and making them available on a no-cost basis to those who have a definite need and application in mind.

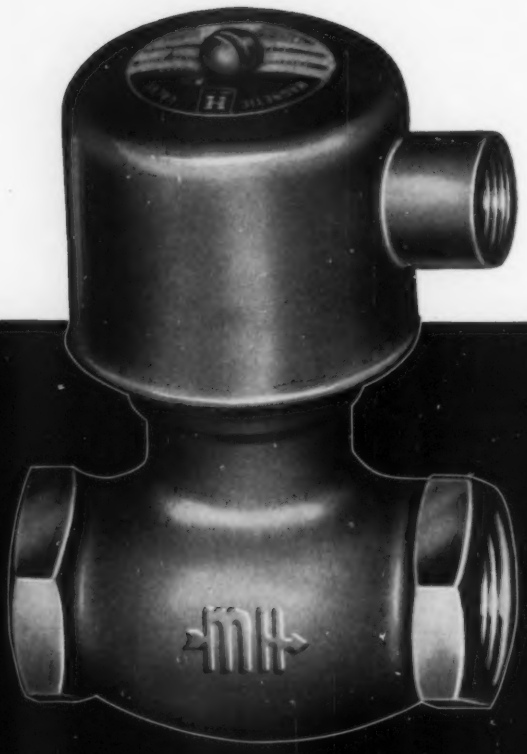
The bulbs are ¼ in. long and 0.045 in. dia, have a light output of 180 millilumens at 1.5 v and a minimum efficiency of 3 lumens/watt. Estimated life is at least 5000 hr.

Information on the Mite-T-Lite bulb may be obtained from R. H. Hodges, Sylvania Lighting Products, 60 Boston St, Salem, Mass. —ARG



Miniature light bulb, goes through a needle's eye with ease. Bulb is less than 3/64 in. dia.

NEW Solenoid Valve V-4019



for water and other light fluids

small in size, high in capacity

APPROXIMATE CAPACITY, GALLONS PER MINUTE, WATER SERVICE

Differential Pressure (psi)	1.25	3	5	10	30	40	50	100
½" Valve	5.6	8.7	11.3	15.6	27.3	31.6	35.2	50
¾" Valve	7.8	12.1	15.6	21.9	38.2	44.2	49	70

Pressure Ratings: Operating pressure—100 psi max.; 1¼ psi min. for full flow. Body rating: 150 psi, nominal body rating

Fluid Temperature Ratings: 125 F max. at 125 F ambient
175 F max. at 77 F ambient

Capacity Index (C_v): ½" size—5, ¾" size—7

Electrical Rating: 120, 208, 240 volt, 50 and 60 cycle ac

Use this pilot-operated, soft-seated solenoid valve for reliable on-off control of water or other light, non-viscous non-corrosive fluids. It's of floating-piston design for quiet operation. The power head can be rotated 360° for ease of wiring. Body material is brass. Can be used for normal and chilled water applications . . . operates from any standard SPST controller or on-off switch.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Control

DEVELOPMENTS TO WATCH...

World-wide

Amplified brain waves can be used to control . . .

. . . prosthetic appliances, and perhaps even machine tools, Soviet scientists believe. Like our own Navy researchers (*PE—Oct 5, p 58*) they've been intrigued by the idea of bioelectronics—the measurement and utilization of electrical changes associated with body functions.

Says A. Kobrinskiy of the USSR Academy of Sciences in Moscow:

"A well-defined dependence exists between muscle tension and the magnitude of bioelectric currents. Within certain limitations it is linear, i.e. the magnitude of biocurrent is proportional to the level of muscle tension. Irritation along the nerve and muscle fibers is diffused in a form of discrete impulses which are modulated in frequency, depending on level of irritation."

These combinations of discrete electric signals, he notes, are similar to those used in assigning work schedules in automatic manufacturing systems.

Taking advantage of these similarities, miniature radio receivers, receiving signals from a transmitter located in a laboratory, have been attached to the bodies of white rats. Sensory and motor reactions of animals have been recorded. Living organisms have received external commands produced by a mechanical apparatus.

A model, shaped in a form of a human wrist, and controlled by means of biocurrents of muscles which flex and straighten the fingers of the hand has also been built (*PE—Nov 10 '58 p. 39*). Now small receiving sets are being developed.

Bioelectronics is in its infancy, he points out, but much can be expected from research on both sides of the Iron Curtain.

Wood that stops neutrons . . .

. . . is made by Permali Ltd of Gloucester, England.

This specially processed material, at least twice as effective a shield as ordinary wood, is much easier to handle than concrete, and nearly as effective as lead and graphite in slowing down fast neutrons.

Known as *Jabroc N*, it's a densified wood with a high hydrogen content that runs over 6% in the minimum-density (84 lb/cu ft) material. It can be loaded with boron or rare earth elements, or laminated to cadmium sheet.

It's not yet available in this country, but arrangements are being made for American production.

A refractory from rice hulls that stands 3000 F . . .

. . . is one of several new materials coming from a long-term Canadian project.

According to Ontario Research Foundation, which developed the material, new processes for combustion of rice hull ash can also produce "a most e cient thermal insulator," an abrasive material, and silicious filler for plastics.

Using technique developed earlier by ORF, at least one Canadian company is already in production of a high-porosity rice hull material which has been formed into porous media for filter plates, and used as an additive for cement and concrete.

The research project is a continuing one, and ORF welcomes inquiries on possible applications.

British motor for vibrating drives

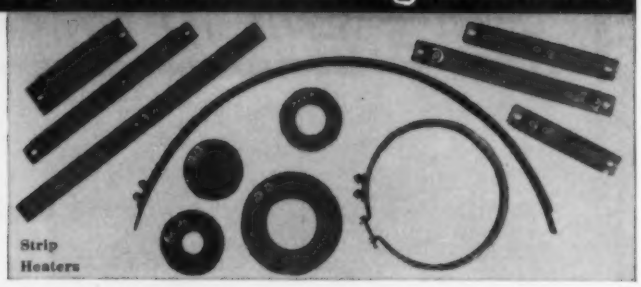
. . . has adjustable out-of-balance weights (see photo) as the vibration source.

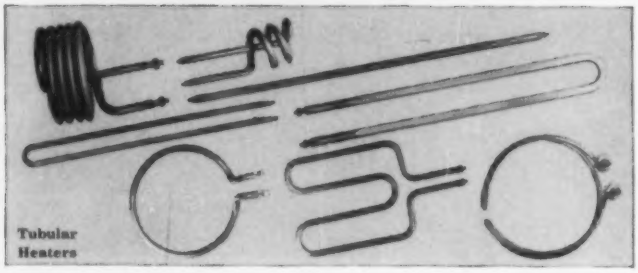
Bearings are specially designed to handle the loads and are permanently lubricated. Centrifugal force at 1500 rpm is 7500 lb; at 3000 rpm, 10,000 lb. Insulation is Class E.

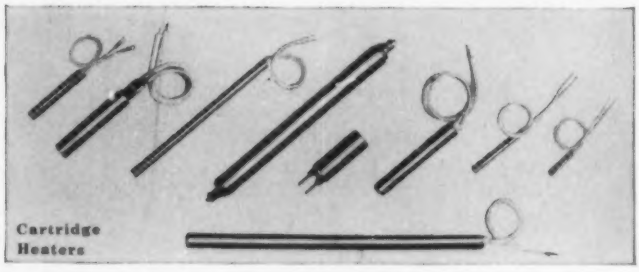
Initial production will be in sizes from ½ to 1½ hp for operation on 3-phase, 50-cycle current at 110 to 650 v; but the manufacturer, English Electric Co, Bradford, England, says "greater outputs and other supply frequencies can be provided." —ARG

Vibrating motor, featuring out-of-balance weights, is designed for screening, conveyer, tamping, and grinding machines. Here, one end cap is removed to show weights.

Call your CHROMALOX Man for the heating answers







These 3 basic CHROMALOX heaters provide answers to just about any heating problem

Strip Heaters . . . that quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens and air ducts. Lengths from 4 to 96 inches, widths from ¾ to 2½ inches, with cross section curving or lengthwise bending. Available with brazed-on fins.

Tubular Heaters . . . that clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Available with brazed-on fins.

Cartridge Heaters . . . that smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Special leads available for protection against flexing action, abrasion, moisture or vapors. Diameters from ⅜ to 1¹⁹⁄₆₄ inches, lengths from 1⅝ to 25⅜ inches.

Versatile Chromalox electric heaters are available in sheath materials and wattages to match almost any application to 1100°F. Easy to install, they are fast, clean, safe and economical.

Your Chromalox Man can help you determine the one that best answers your specific problem. He's backed by the world's largest factory stock of industrial heaters, ready for immediate shipment. Why not give him a call. You'll find his phone number listed at the right.

Our new Catalog 60 provides detailed product information and suggests numerous applications for the complete line of Chromalox electric heaters for industry. If you have not yet received a copy, please let us know. 1601

Sales-Engineering Representatives

Atlanta, Ga. TRinity 5-7244
Bala-Cynwyd, Pa. MOhawk 4-6113
Baltimore, Md. HOpkins 7-3280
Binghamton, N. Y. RA 4-7703
Bloomfield, N. J. EDison 8-6900
Boston, Mass. LIberty 2-1941
Buffalo, N. Y. SUmmer 4000
Charlotte, N. C. EDison 4-4244 FRanklin 5-1044
Chicago, Ill. HArrison 7-5464
Cincinnati, Ohio TRinity 1-0605
Clearwater, Fla. Phone 3-7706
Cleveland, Ohio PRospect 1-7112
Dallas, Texas RIverside 1-9004
Davenport, Iowa Phone 6-5233
Denver, Colo. GLendale 5-3651 GEnesee 3-0821
Des Moines, Iowa CHerry 3-1203
Detroit, Mich. UNiversity 3-9100
Houston, Texas CApitol 5-0356
Indianapolis, Ind. MElrose 5-5313
Kansas City, Mo. VIctor 2-3306
Los Angeles, Calif. RIchmond 7-5191
Middletown, Conn. DIamond 6-9606
Milwaukee, Wis. BRoadway 1-3021
Minneapolis, Minn. FEderal 6-6631
Nashville, Tenn. CYpress 2-7016
New York City, N. Y. WOrth 4-2990
Omaha, Nebraska ATlantic 7600
Philadelphia, Pa. GReenwood 3-4477
Pittsburgh, Pa. EMerson 1-2900
Portland, Oregon CApitol 3-4197
Richmond, Va. ATlantic 8-8758
Rochester, N. Y. HAmilton 6-2070
St. Louis, Mo. CHestnut 1-2433
San Francisco, Calif. UNderhill 1-3527
Seattle, Wash. MAin 4-7297
Syracuse, N. Y. HOward 3-2748
Wichita, Kansas AMherst 2-5647

CHROMALOX
Electric Heat
INDUSTRIAL • COMMERCIAL • RESIDENTIAL
EDWIN L. WIEGAND COMPANY
7935 THOMAS BLVD., PITTSBURGH 8, PA.

DEVELOPMENTS TO WATCH...

Washington

News about thermocouple developments . . .

will be announced by the Navy any day now. It will announce contract awards to two companies to build two 500-watt portable generators that can turn out 28 volts dc. Each of the generators must be air-cooled and weigh no more than 25 lb. Navy expects to have the units in operation within a year.

Navy is handling the project for the Marine Corps. It plans to use the equipment for field communication and possibly radar.

More than 35 companies are bidding for the Navy contract. Many of them, Navy says, are willing to share much of the developmental expense, estimated to run around $200,000. The reason is the potential commercial use of such generators.

The generators will be fueled with kerosene or gasoline. Efficiency is not a prime factor in developing the units, Navy says. It most likely won't go much over 10%.

By early next spring, the Navy also plans to have two 5-kw generators installed at its US Naval Engineering Experiment Station at Annapolis, Md.

Carrier Corp is building one of these generators under a $194,000 contract, and Westinghouse the other under a $342,475 contract. The generators will be hooked up to a solid state inverter to turn out 5 kw in alternating current.

Efficiency will be around 15 to 16%—rated on energy flowing through the thermocouple only. It is the highest yet attained for a unit of this size, and will be the largest known thermoelectric unit in the world. It compares to the 20 to 25% efficiency of conventional ship plants. Although the Russians are working in this field, guessing is that they don't have a unit this large either.

The long range goal of the Navy is to push its nuclear-powered submarines around oceans with thermoelectric power. Such a move has a dual purpose, weight reduction and silent operation. Noise is one of the biggest drawbacks attached to the nuclear submarine fleet. They are considerably noisier than conventional subs and thus easier to detect by the enemy.

A shift in Air Force policy . . .

has been made on development of big weaponry projects. It showed recently when the Air Force let the contracts to develop the Dyna-soar. This is a manned space ship on the "boost-glide" principle that will be blasted into orbit by a ballistic missile. The method of procurement shows a trend away from the "weapons system" concept which means giving one prime contractor responsibility for the entire project.

Boeing Airplane Co will design and build the vehicle, and the Martin Co will produce the rocket launcher. Some $53 million will be spent on the project this year.

The change in Air Force policy showed when it awarded separate prime contracts to both Boeing and Martin, then directed the two companies to select producers for major sub-systems and components "on a competitive basis regardless of previous working relations" that existed before. It means the Air Force will have a stronger role in handing out subcontract work.

Previously, once a prime contractor was designated, subcontract work was left pretty much up to the prime. This was done for such projects as the B-58 and B-70 bomber programs, the Atlas and Titan missiles, etc.

Speculation is that the move stems from Congressional criticism that too much of the defense dollar is going to a chosen few contractors, and not always to the benefit of the government.

Budget talk will increase . . .

in the next few weeks. The Administration's drive to hold defense spending down to this year's $41 billion level is already getting a fight from the services as they see some of their projects eliminated and others pared back sharply.

One example from the Navy: unofficial reports have it that Navy wants to build an acoustic analyzing laboratory as part of its anti-submarine warfare program. The lab would be used to sift out information on Soviet submarines and surface ships that it collects acoustically around the world. This provides valuable information on the speed, propulsion system, etc of enemy vessels.

Reportedly the project won approval from the Secretary of Navy only to be thrown out by the Secretary of Defense. Navy undoubtedly will find money to build its laboratory, but the case illustrates how service budget requests are being trimmed.

WHAT'S HAPPENING IN... Science

How much dirt?

To replace time-consuming visual counts of dirt specks on paper and other materials, Kimberly-Clark's R & D Lab now has an automatic photoelectric device that's faster, simpler, and more accurate.

As described by W. H. Cuffey and L. W. Zabel of K-C, the instrument works this way:

A sample is mounted on a rotating table so that it passes beneath a photoelectric viewing assembly containing a phototube.

The phototube produces an electrical pulse whose amplitude depends on the amount of light reflected from the sample—an amount that decreases whenever a speck of dirt appears.

A counting unit amplifies these pulses, sorts them into 3 groups on the basis of pulse height and indicates the number of specks viewed.

The scanning arrangement is particularly interesting: The sample-holder (see diagram) is a porous bronze plate, attached to vacuum line so that the sample can be held down by suction. It is driven by synchronous motor at 5 revolutions per sec and is mounted on an oscillating bar.

A second motor, operating at 17 rpm. drives the cam which moves the oscillating bar. The cam is cut so that the paper is moved radially just the width of the viewed area on the sample during each revolution of the plate. This means the viewed area moves in a spiral path, and there is no blank space or "seam."

In one respect, the test does differ from a visual count: amplitude of the pulse depends on area as well as light reflectance, so the unit gives an indication of amount of dirt as well as number of specks.

More power from synthetic elements

When Mendeleev finished with his periodic table of the elements, there were 92—but with several blank spaces. Today, all the original 92 have been found or made, and 10 more have been added. None of these later elements exists in nature, and only one—plutonium—has been produced in quantity. But AEC now plans to make others available for research, and scientists are getting ready to put them to work as power sources.

Says Dr W. T. Crane of Martin Co: "There are only two systems developed to date that will furnish a source of electrical energy in a lightweight package for space missions longer than a few days. These are solar cells and isotopic power sources; and for some special missions only isotopic power is practical (e.g. a hard landing on another planet such as Venus)."

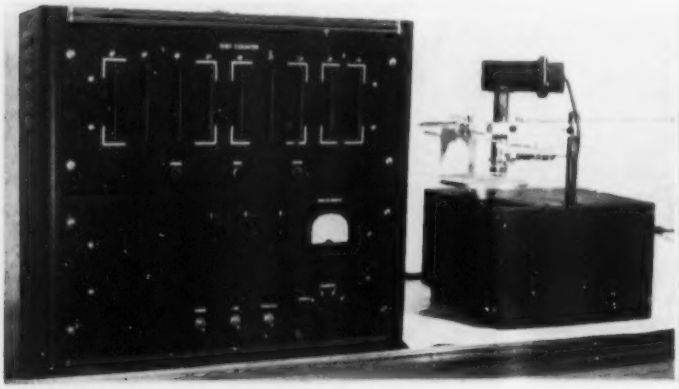
Best source of isotopic power for space appears to be the transuranium elements. Three of these seem most promising: curium-242, curium-244 and plutonium-238. They offer high power density and are relatively safe and easy to handle because their primary radiation is in the form of easily screened alpha particles.

Equipment is already being designed to use these isotopes (*PE—Feb 23, p 7*); but until they become available in larger quantities, such naturally occuring alpha emitters as polonium must serve as stand-ins.

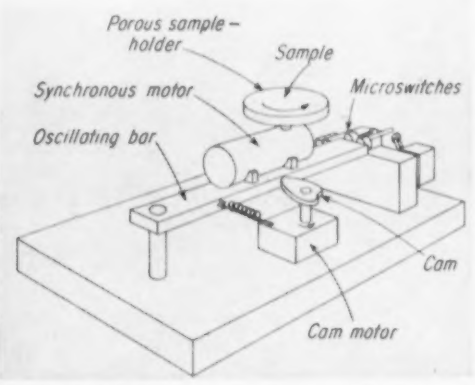
brief . . .

Teinograph is another new word to add to your glossary. It's a name coined by GE engineers for a new device for displaying and recording high-voltage transients. Teinograph is derived from the Greek *teinen*, to stretch out; and *graphos*, to write; and the teinograph does indeed stretch out the transient wave in space or time and write it down (record it).

Compared to oscillographs, often used to study lightning discharges and switching surges, J. G. Anderson and R. U. Giacomoni of GE say the teinograph is small, simple, and potentially low in cost. —ARG



Dirt counter consists of sample-holder (see diagram), viewing microscope, with illuminator, phototube, and three-channel electronic indicator. It's designed to replace time-consuming visual method.



Sample holder is porous bronze plate, attached to vacuum line so sample can be held by suction. Microswitches, activated by oscillating bar, control counters.

WHAT'S HAPPENING IN... Materials

Stopping titanium's creep

Titanium is an excellent diaphragm material for microphones, telephone receivers, and other acoustical applications, Nippon Telegraph & Telephone Corp engineers note. But what of its tendency to creep under continuous stress unless it has been aged a long time? The Japanese say they've found a way to accelerate that aging process and produce diaphragms whose efficiency is "substantially invariable."

The method, which they have patented: heat treatment after forming (at about 400 F for 6 to 10 hr in air) at the point where tension is applied.

This forced aging, they say, substantially eliminates creep and stabilizes resonance frequency at a point "which otherwise might not be reached until the diaphragm had been left to stand for decades."

Coating process revealed

Details of a fused-salt process for applying protective metal coatings to corrosion-sensitive metals become available with release of an AEC patent that has long been held secret because of its importance.

The process, which uses molten alkali-metal salts as "solvents," was originally developed for cladding uranium-reactor fuel rods. But the patent indicates it has far wider application—almost anywhere it is desired to coat a more-active metal with a less-active one. L. D. Eubank, inventor of the process, says it's especially valuable for applying thin coatings that can serve as a basis for further treatment—hot-dip coating or electroplating; and for temporary protection of parts during forming operations.

Such metals as Zn, Sn, Pb, Cu, Al, Cr and Ni may be applied to iron and carbon steels and Cr and Ni to Mg and Al.

For the original work, such solvent formulations as Ru-Li-Na-Cl and Cs-Li-Na-Cl were used because they permit application temperatures as low at 600 F. However, Eubank notes that less-expensive mixtures may be prepared (K-Li-Na-Cl, for instance), if somewhat higher temperatures are permissible.

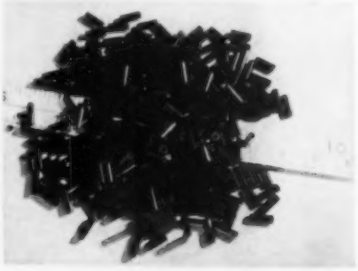
The patent, #2,872,348, gives a number of specific bath formulas and summarizes application procedures.

New materials for electronics

To meet the growing demand in electronics for ultrapure metals and special materials to go with them, several new companies are being formed, and well-known suppliers are introducing new products.

Accurate Specialties Co, for instance, has a new subsidiary, High Purity Metals Inc, which plans to offer six "electronic metals" in purities better than 99.99%. The metals, and purities promised: Aluminum: 99.999+; Gallium: 99.999; Indium: 99.999+; Lead: 99.9999; Tin: 99.999. In addition, the company, to be located at 340 Hudson St, Hackensack, NJ, promises to add germanium "of semiconductor quality" and other metals to its list in the future.

Semimetals Inc, a subsidiary of General Transistor Corp, is making news in germanium too. It has cut the price of the single-crystal material from $650 to $629/kg. That doesn't sound cheap; but in the gram quantities normally used, it means the price is down from 65¢ to less than 63¢; and, says Semimetals, "each crystal is supplied with its own resistivity profile and comes sealed in a polyethylene plastic bag."



Black glass cases for silicon diodes are typical of special materials now being made for electronic use.

To protect semiconductor materials from undesirable radiation, Corning Glass Works is offering a new blacker-than-black glass that "filters out virtually all ultraviolet, visible, and near-infrared radiation." Corning expects it to permit economies in manufacture of electronic devices by eliminating the need for painting or other types of screening. Corning will supply the material in beads and cases of various sizes.

Note: For information on properties and applications of the rare metals in this group, see *PE*—Mar 17 '58, p 66).

briefs . . .

Silicon-based compounds that have unusual resistance to heat, radiation, and oxidation may offer a new route to high-temperature lubricants, hydraulic fluids and dielectric materials. Air Force researchers report that perarylated silanes that stand temperatures to 1100 F have already been made, and urge further research on this class of compounds. A copy of the report on their initial investigation is available from OTS, Dept of Commerce, Washington 25, DC. It's PB 151,860, 22 p, 75¢.

Elastic urethane fibers are nearing commercial production, and promise "a pulling force stronger than that of natural rubber and an unusually long life." Several companies are working on them because, as Dr Seymour Polansky, director of R & D at Globe Mfg Co, told a recent ACS textile symposium, they are light in weight, light in color, and have excellent flex life and durability. —ARG

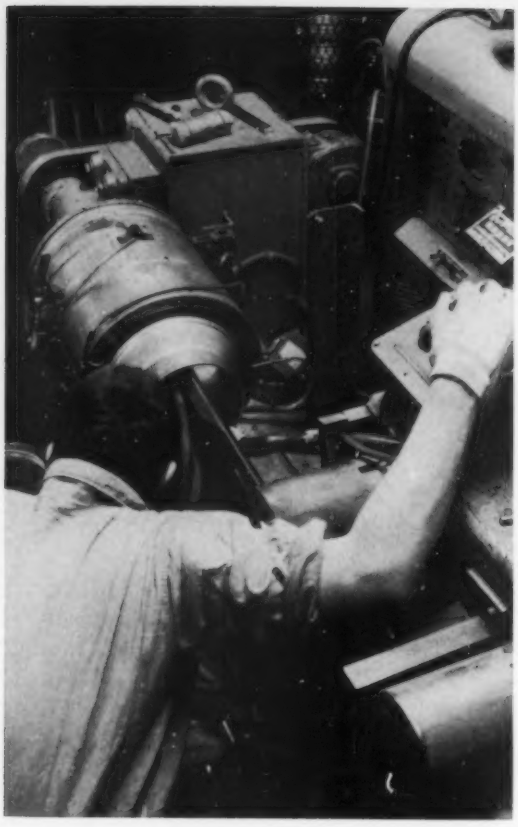
Jointly, We've come a long way since man first found that he could unite pieces of metal by

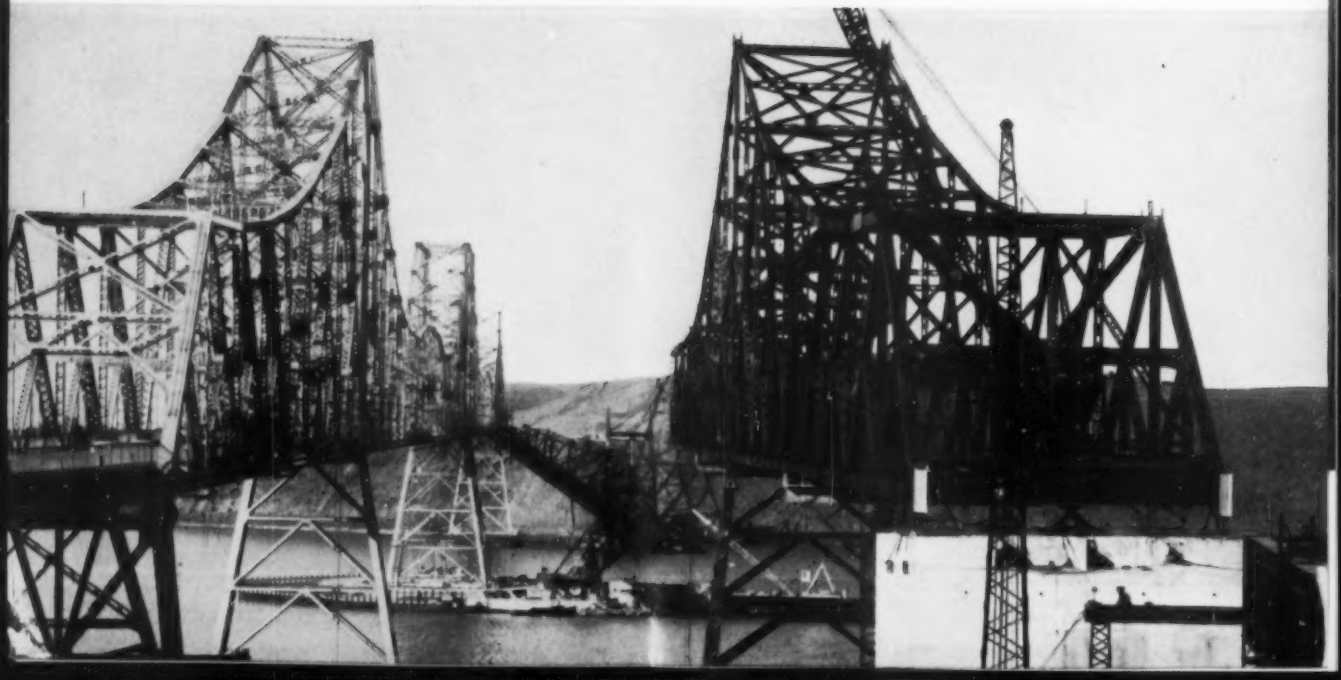
No matter what technique you use, the finished joint is best when the welded material is steel.

STEELS FOR DESIGN

beating them together while they were hot. Now there are almost 40 different welding techniques.

Above, you see a close-up photograph of arc-welding. For a more complete picture of welding, turn the page. ▷ ▷ ▷





STEELS FOR DESIGN

Stainless Steel makes a flawless milk can—Milk cans have to be surgically clean. That's why the John Wood Company makes them from Stainless Steel, with **welded** joints. Here, you see a "Heli-arc" welding machine that was specially designed to weld the inside bottom and outside bottom of the can in one operation. The welding head is retracted to the breast of the can where again, the inside and outside welds are done in one operation. A nipple is gas-welded to the bottom of the can and all the joints are polished to a mirror finish—ready to pass microscopic inspection. Because of the outstanding design and fabrication processes developed by this company, they are now equipped to produce 50% of all the Stainless Steel can requirements for the entire dairy and vending machine industries.

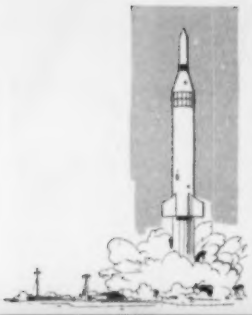
USS "T-1" Steel stops saddle block failure—A saddle block links the dipper stick to the boom of a power shovel (see arrow above) and provides the digging effort. It has to withstand tremendous stress and shock—failures are not uncommon. But one operator had too many saddle block replacements so he asked J. B. Lund's Sons Co. to make a stronger unit. The conventional solid cast steel or forged steel block would have been too vulnerable, so the additional strength had to come from a **welded** assembly of strong steel plates. But the higher carbon content that increases the strength of most types of steel also decreases the weldability. They solved the dilemma with USS "T-1" Constructional Alloy Steel. "T-1" brand is a **low** carbon, quenched and tempered alloy steel with tremendous strength—100,000 psi minimum yield strength. The photo shows the finished block made from "T-1" steel plates that were edge-welded 1¼" deep. This block has never failed.

High Strength Steel cuts dead weight—You can stand beside the Carquinez Strait in California and size-up thirty years advancement in bridge building. There are two spans there, side-by-side; one is 31 years old, the other was completed last year. The builders of the new span saved 2,128 tons of steel because they designed the new Carquinez Strait Bridge with USS TRI-TEN High-Strength Low-Alloy Steel and USS "T-1" Constructional Alloy Steel. With yield strength levels of 46,000 psi min. and 90,000* psi min., respectively, these ultra-strong steels permitted thinner, lighter truss members that were shop-welded instead of riveted. 100% efficiency butt welds saved 20% in the weight of tension members by providing extra material at the holes for the connection bolts. The smooth, rivet-free surfaces are less vulnerable to corrosion . . . save thousands of dollars in maintenance.

USS, "T-1" and TRI-TEN are registered trademarks

United States Steel USS

*Now 100,000 psi for plates up to 2½ inches.

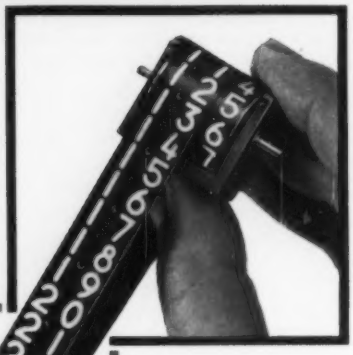


Precision Readout Counters for navigational and control systems include Tandem counters (left), concentric drums, and multi-bank types. "Application Engineered" as complete packages.

PRECISION readout (DIGITAL IN-LINE) COUNTERS

High Speed Counter works at 1000 rpm with low torque and miniature size. For aircraft fuel-flow meter and similar applications.

New Concepts in Fast, Accurate Data Presentation



Precision Counter has completely internal supporting structure for instrument applications requiring extreme compactness, light weight and ruggedness. Three or five wheels, numerals in enamels or fluorescent paints.

New 360° Tape-Type Bearing Counter recently developed for digital readout of angular relationship. Tape greatly reduces size and weight over conventional devices. "Application Engineered" as required.

Now you can use modern digital readout whenever extreme accuracy and precision indication are required. Veeder-Root Instrument-type Counters have "Application Engineered" tolerances, meet severe environmental specifications, operate accurately at high speeds, and offer wide selections of gearing and package designs.

Here are just a few of the ways Veeder-Root Precision Readout can improve and simplify product operation and performance . . .

- Figures and letters are positive, and easily comprehended
- In-line presentation more *quickly* read
- Replaces micrometer and vernier devices
- Maximum readability in miniature sizes
- Fractions, degrees are positively displayed

High speed miniature counter suitable for applications requiring small size and weight, low torque and low cost. External pinion, ½" wheels, ⅛" characters.

Take full advantage of digital readout with Veeder-Root Precision Counters — for military, aircraft, missile and industrial instrumentation. Standard types and special designs for all types of application, and design assistance is available from Veeder-Root Counting Engineers. Write or call.

Veeder-Root

HARTFORD 2, CONNECTICUT

"The Name that Counts"

New York • Chicago
Los Angeles • San Francisco
Seattle • St. Louis
Greenville, S. C. • Altoona, Pa.
Montreal
Offices and Agents in other principal cities

VRD-88

Product Engineering **HORIZONS**

November 30, 1959

GENERALIZING ON GENERALS

Philip of Macedon once said: "Alexander will become a great general because, of all my soldiers, he knows best how to obey." Even allowing for a father's pride, the statement was–and is–correct. Alexander became the greatest general of his time.

Too often, the man with a desire to lead has no parallel understanding of how to follow. He may excuse the lack as individuality or independence, but it is in truth sublime egotism–the inability to take orders.

Some independence is essential; the engineer who can't stand on his own hasn't much to offer. Part of his job is the readiness to stand alone. He rightly should challenge a dubious decision. But part of his job too, is the ability to work with others, and the man who can't take orders usually can't issue them either. He has troubles with associates, shop men, technicians, specialists, secretaries; they "don't understand him." He feels, much of the time, that he should have more authority, more assistance, but fails to use either efficiently when they're provided. He feels also that no one can do any job right except himself. He is always critical, very rarely complimentary.

Back of his attitude is insecurity. He tries to appear superior and overdoes it. He is overly conscious of title, position, perquisites. He demands all the privileges due his rank or position; he'd make the kind of army officer whose men think seriously of shooting, or the civilian who can't keep an assistant, a secretary, a boss—or even a job.

The Labrador Esquimaux have a simple method for teaching limits and obedience. When a puppy puts his head into the tent or house, the father instructs the youngest child to pick up a stick and bat the puppy's nose. Thus child and pup both learn a lesson. And, contrary to our civilized exponents of the spared rod, both child and pup grow up with manners and a sense of responsibility. (Perhaps it is the spared rod in our civilized progressive system that creates disobedience in the first place. Every animal, and every savage, knows that disobedience in a child can endanger everybody else. So disobedience is punished when it starts, not when it's in full flower.)

Discipline is not a sometime thing. It's a wearisome job, but must be an unremitting one. And it must be tempered to the offense. Too often, it is clamped down suddenly and unexpectedly, after a long period without it. Such off-again, on-again tactics inevitably cause chaos. And they reveal something else–egocentricity in the boss.

Gallon and Quart bottles courtesy of Vanguard Plastics, Inc., Freehold, N. J.

O-o-o-o-o-p-s !

Thud! No crash, splatter, splash! But just plain thud! This bottle resists breakage because it's made of SUPER DYLAN® high density polyethylene. The gallon size weighs only 3½ ounces, yet it protects its contents . . . and the user, too! It's the bottle with the built-in bounce!

More than shatterproof, SUPER DYLAN bottles are rigid and light in weight—less than 1/10 the weight of gallon *glass* bottles. Needless to say, lightness like this cuts shipping expenses and simplifies handling.

Cost? Very economical. For sheer good looks you can just about name the color you want in SUPER DYLAN. Printability? It's easy by normal procedures.

SUPER DYLAN can be easily blow-molded into bottles of all sizes and shapes. You can use it to package almost anything. Acids, sure. Detergents, too; and cosmetics, pharmaceuticals, bulk chemicals, shampoos and food products. SUPER DYLAN resists heat and can be readily sterilized.

Write for more information on SUPER DYLAN high density polyethylene for bottles. Koppers Company, Inc., Plastics Division, Dept. PE-1192, Pittsburgh 19, Pennsylvania.

Offices in Principal Cities · In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario.

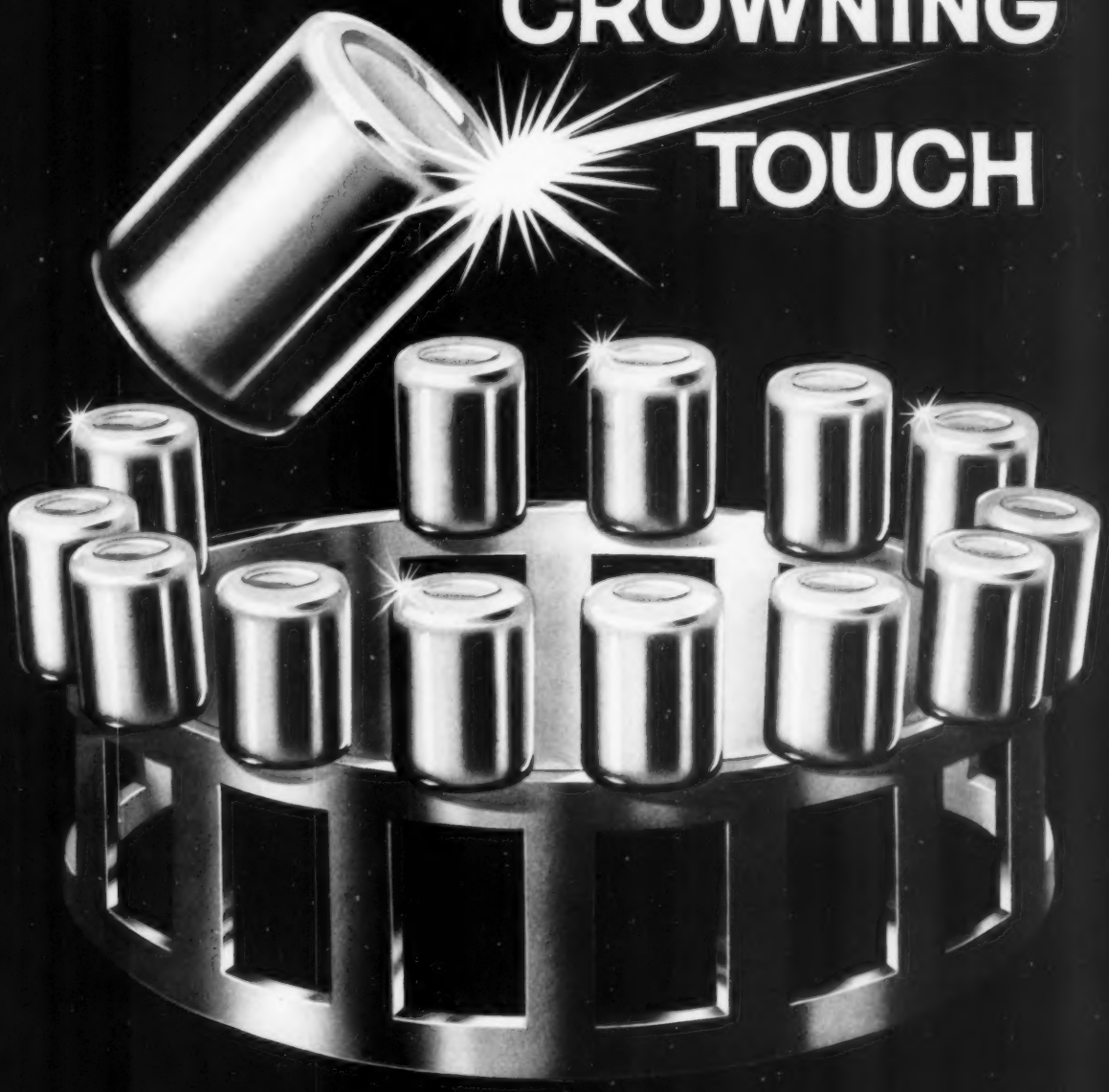
KOPPERS PLASTICS

DYLENE® polystyrene, DYLITE® expandable polystyrene, and DYLAN® polyethylene are other fine plastics produced by Koppers Company, Inc.

KOPPERS

CIRCLE 20 ON READER SERVICE CARD

THE "CROWNING" TOUCH



makes things run smoother on

HYATT HY-ROLL BEARINGS

IN ROLLER BEARINGS HYATT IS THE WORD FOR GM GENERAL MOTORS RELIABILITY

CROWNED ROLLERS and HYATT

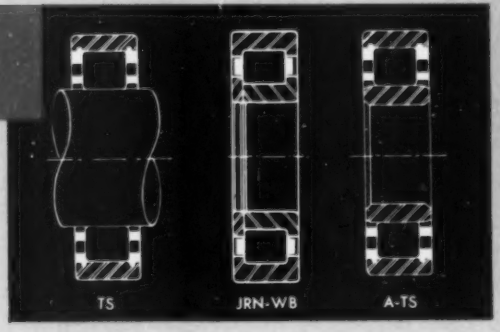
assure 3 performance advantages

Grinding a gentle crown on cylindrical rollers, a practice pioneered by Hyatt, provides definite operating advantages in a finished bearing.

When a cylindrical roller is rolled across a flat plate there is a tendency for the imposed loads to be concentrated toward the roller ends. When rollers are assembled into bearings this condition is exaggerated, somewhat, particularly if there is a condition of misalignment.

All rollers in Hyatt Metric Series Radial Bearings are crowned. This crowning reduces the tendency toward end loading and the effective load is spread more evenly across the full length of the roller even under misalignment.

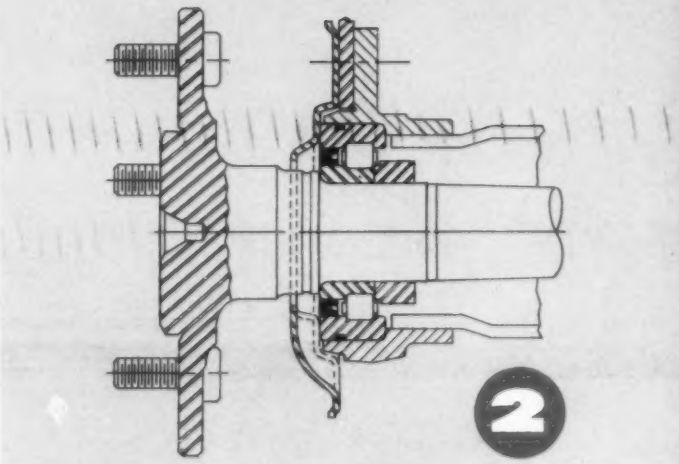
3 KEY BENEFITS WITH HYATTS



● **ALL HYATT HY-ROLL METRIC SERIES BEARINGS** have rollers with ample crowning in addition to generous corner radii or blended chamfers. This crowning extends a sufficient distance in from the ends to allow the area of contact to "fade out" evenly under normal loads, and to minimize excessively high unit loads caused by possible misalignment. This feature, another HYATT "first", assures a quieter, smoother running and longer lasting bearing under all operating conditions.

● **THE LOW LENGTH-DIAMETER RATIO OF HYATT ROLLERS** eliminates virtually all tendency to skew, which can be troublesome in bearings having a different roller length-diameter ratio. By most closely approaching true rolling action, HYATT Hy-Rolls assure less friction, less wear on rollers and races, and increased service life.

● **GREATER LUBRICATION CAPACITY IS ANOTHER ADVANTAGE** of expertly-engineered HYATT Hy-Roll design. HYATT Hy-Rolls are easy to keep properly lubricated for efficient, economical performance and trouble-free maintenance.



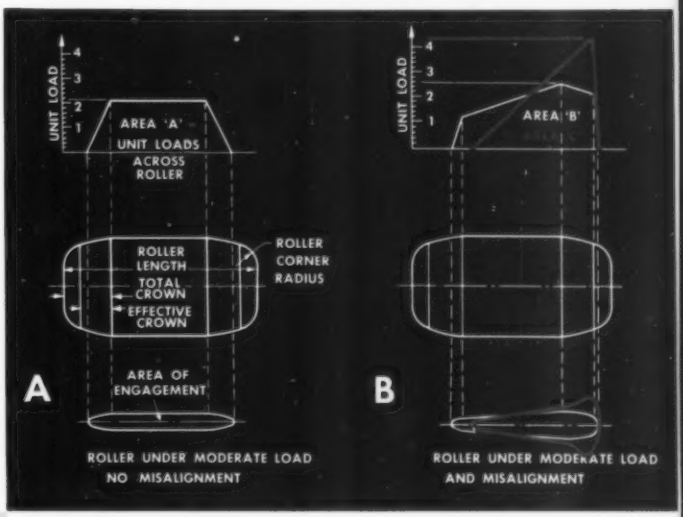
NO BEARINGS CARRY RADIAL LOADS LIKE CYLINDRICAL

LENGTH TO DIAMETER RATIO

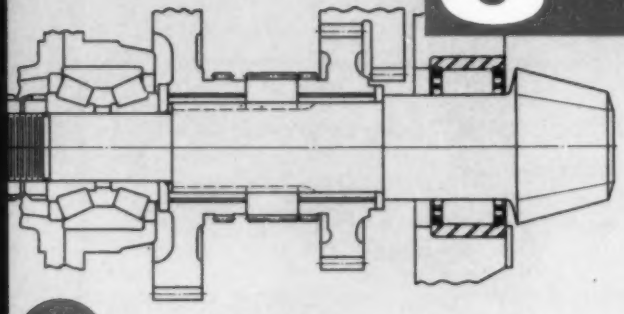
when you design around HYATT metric series bearings

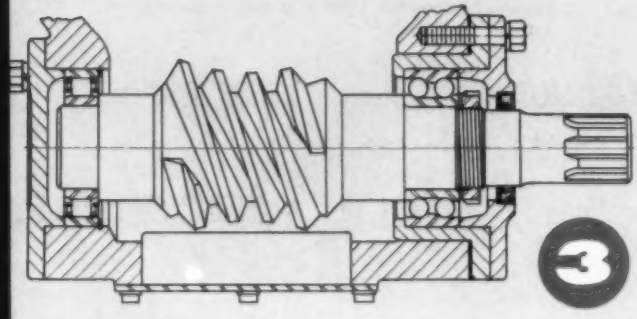
Balanced design is the key to improved field performance of bearings. The relationship between inner races, outer races, cages and rollers must be carefully evaluated because a bearing, like a chain, is only as good as its weakest component.

There is a relationship between the load carrying capacity of a cylindrical bearing and the area of contact between the rolling elements. Over long years of test and evaluation Hyatt has established a roller length to diameter ratio which provides maximum capacity with optimum roller retainment and guidance. The proportions used in Hyatt Bearings have stood the test of time and field usage to become the standard for cylindrical roller bearings.



3 TYPICAL APPLICATION EXAMPLES





1 OVERHUNG PINION IN LIFT TRUCK TRANSMISSION A HYATT Hy-Roll Type TS bearing provides the load-carrying capacity so necessary in this heavily loaded position. By eliminating the separable inner race, it was also possible to use a larger, more rigid pinion shaft without disturbing the boundry dimensions of the bearing. Roller crowning improves performance and compensates for inability to bring shaft finishes up to bearing inner race standards.

2 TWO-DIRECTION AXIAL SHAFT LOCATION Misalignment present in an application like this automotive rear axle requires the compensating effect of a crowned roller. HYATT Hy-Roll Type JRN-WB bearings have proved extremely successful in applications of this type.

3 WORM AND GEAR APPLICATION A double-row ball bearing is used for locating this shaft in both directions. The A-TS bearing at the opposite end is used with a cartridge that facilitates adjustment by shimming. Using a cylindrical bearing at one end facilitates assembly and permits easy removal of the worm from the case. Crowned rollers improve load carrying capacity and compensate for misalignment resulting from gear loads in shaft.

BEARINGS . . . AND NOBODY KNOWS THEM LIKE HYATT

YOU CAN RELY ON THE ADVICE OF YOUR HYATT SALES ENGINEER

...and the bearings he recommends!

You get the greatest benefit from HYATT engineering service when a HYATT representative is working closely with you on your bearing requirements. This service is available to you at any time. When you have questions that lend themselves to immediate answers, such as price, delivery or specifications of standard bearings, a telephone call can usually provide the necessary information.

just call your nearest **HYATT** *office:*

HARRISON, NEW JERSEY
427 Middlesex Street
Harrison, New Jersey • HUmboldt 4-4000

CHICAGO
332 S. Michigan Avenue
Chicago 4, Illinois • HArrison 7-8277

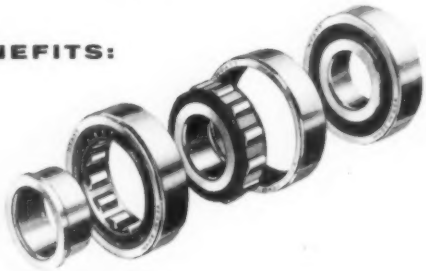
DETROIT
General Motors Building
Detroit 2, Michigan • TRinity 3-7200

PITTSBURGH
702 Grant Building
Pittsburgh 19, Pennsylvania • ATlantic 1-2927

OAKLAND
1419 Central Bank Building
Oakland 12, California • Twin Oaks 3-5362

REMEMBER THESE BUILT-IN HYATT BENEFITS:

- Higher radial load-carrying capacity, size for size
- Minimum space requirements
- Omitted races are optional
- Shaft location without sacrificing capacity
- Easier assembly and disassembly
- Heavier press fits simplify retainment



THE RECOGNIZED LEADER *IN CYLINDRICAL BEARINGS*

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

Steel Strike Pushes Much Capital Spending Into 1960

Survey by McGraw-Hill Department of Economics indicates $37.3 billion will be spent on plant and equipment next year; sales are expected to rise 9% in manufacturing industries. Heavy capital outlays planned by metalworking.

NEW YORK—Investment in new plant and equipment next year may not be the highest in US history, but it will be very substantial indeed and will provide a considerable bulwark to the economy. Industry as a whole (manufacturing plants, utilities, transportation and communication firms, commercial establishments) will spend $37.3 billion on capital improvements —a 10% gain over 1959. These findings are based on a survey by the McGraw-Hill Department of Economics.

Nearly four months of steel strike have left a deep imprint on the pattern of spending, the survey states. Industry now reports that actual spending this year fell short of anticipated. This is especially true for firms directly affected by the strike—steel and railroads —and for nonferrous metals firms. Since the beginning of the strike, steel companies have been barred from entering their plants to carry out improvements. And traffic losses on the railroads have impaired their ability to finance improvements.

But there is evidence in the survey that these industries have postponed rather than cancelled spending plans. The steel industry, for example, will spend $1.7 billion next year—a gain of 76% over 1959 and only $176 million below record 1957.

For manufacturing companies alone, capital spending in 1960 will total $12.0 billion—19% more than this year. The machine industry emerges as one of the heaviest spenders with $1.2 billion of plans now on tap—a 22% gain over this year. In 1961, machine companies report, they will probably maintain this spending level.

Other substantial increases are expected in the electrical machinery and auto industries. Firms in the electrical machinery industry say that they'll spend $582 million, a gain of 22% over this year. And the auto industry will spend $841 million, a gain of 30% over this year. Both these industries failed to meet capital improvement plans this year, presumably because of strikes and other uncertainties. The high level of spending next year suggests that unfinished plans are being pushed into 1960.

Transportation equipment industry (including aircraft, ships and railroad equipment) will spend nearly $400 million next year—a 10% rise over this year. But other metalworking industries—a category that includes fabricated metals and instruments—will cut allocations to capital improvements by about 1%.

These rather buoyant investment plans are backed by optimistic sales forecasts, the survey finds. Manufacturing companies, as a whole, expect their sales to rise 9% above this year. Every major industrial category within manufacturing expects some improvement in business. The steel industry predicts a 25% gain in sales volume. This forecast presumably reflects an anticipated buildup of inventories by consumers whose stocks have been depleted by the strike.

The auto industry expects a 15% gain in sales next year. Manufacturers sales to dealers have slowed this fall following production cutbacks caused by the steel strike. Normal 1959 sales will be deferred to 1960. Both machinery and electrical machinery expect above average increases in sales volume.

Companies reporting their financial

CAPITAL SPENDING PLANS ARE ON THE RISE
(Millions of Dollars)

Industry	1958 Actual	1959 Est	1960 Planned	1959-60 % Change	1961 Planned
Iron & Steel	$1,217	$949	$1,670	+76%	$1,169
Nonferrous Metals	510	347	357	+ 3	350
Machinery	915	951	1,161	+22	1,129
Elec Machy	459	477	582	+22	559
Autos, Trucks & Parts	558	647	841	+30	791
Transp Equip	370	363	399	+10	359
Other Metalwkng	723	880	875	− 1	844
Chemicals	1,320	1,188	1,473	+24	1,502
Pulp & Paper	578	613	828	+35	704
Rubber	134	178	233	+31	274
Stone, Clay, Glass	399	542	603	+11	594
Petroleum Ref	665	692	754	+ 9	814
Food & Beverages	742	794	783	− 1	737
Textiles	288	343	361	+ 5	350
Misc Mfg	883	1,061	1,037	− 2	1,022
ALL MANUFACTURING	**9,761**	**10,025**	**11,957**	**+19**	**11,171**
Trans & Communications	4,653	5,184	5,896	+14	5,503
Elec & Gas Utilities	6,088	5,876	6,066	+ 3	5,768
Other industry*	12,254	13,521	14,145	+ 5	12,938
ALL BUSINESS	**32,091**	**33,914**	**37,310**	**+10**	**34,566**

*Includes petroleum, other than refining, mining and commercial businesses

INDUSTRY FORESEES SALES GAINS, 1959-'60

Industry	Expected Change in Physical Volume
Iron & Steel	25%
Nonferrous Metals	7
Machinery	11
Electrical Machinery	11
Autos, Trucks & Parts	15
Transp. Equipment (aircraft, ships, RR equip.)	4
Other metalworking	7
Chemicals	9
Paper & Pulp	6
Rubber	7
Stone, Clay, Glass	7
Petroleum Refining	3
Food & Beverages	5
Textiles	8
Misc Manufacturing	7
ALL MANUFACTURING	9

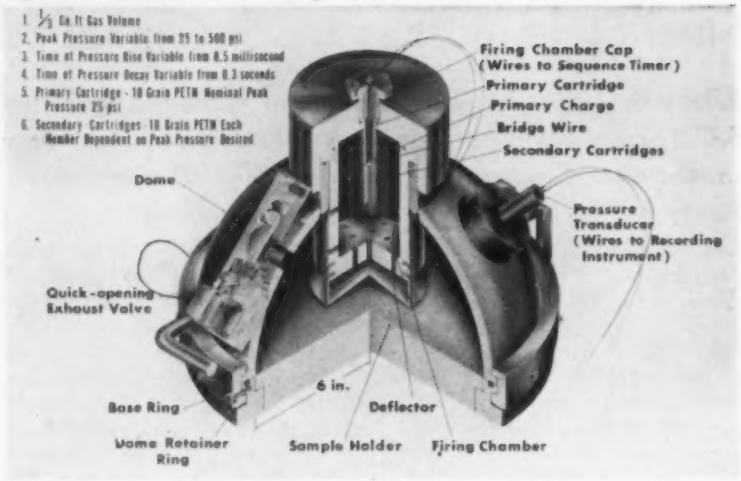
plans to the surveyors indicate they will need $6 billion from outside sources to finance these capital improvements. Manufacturing companies, however, expect to finance nearly all spending from internal sources. ■

Rocket-ramjet Engine Combination Tested

VAN NUYS, CALIF—An advanced power plant which integrates the best features of the ramjet and rocket systems in a single propulsion unit, was operated at simulated flight speeds in excess of five times the speed of sound at altitudes above 100,000 ft. Dubbed the "Hyperjet" by the builder, Marquardt Corp, the tests were conducted at the Ordnance Aerophysics Laboratory, Dangerfield, Texas.

The tests prove that transition from rocket to ramjet operation is feasible and that at sea level conditions the engine produces a high level of static thrust. The Hyperjet operates as a rocket during launch, low-speed boost, space flight, and reentry phases, using a stored oxidizer to effect combustion. The engine operates as a ramjet during high-speed boost and hypersonic cruise phases, relying on the atmosphere for its oxidizer supply, according to the Marquardt Corp. ■

Dynamic Tool for Testing


1. 1/3 Cu. Ft Gas Volume
2. Peak Pressure Variable from 25 to 500 psi
3. Time of Pressure Rise Variable from 0.5 millisecond
4. Time of Pressure Decay Variable from 0.3 seconds
5. Primary Cartridge - 10 Grain PETN Nominal Peak Pressure 25 psi
6. Secondary Cartridges 10 Grain PETN Each Number Dependent on Peak Pressure Desired
Firing Chamber Cap (Wires to Sequence Timer)
Primary Cartridge
Primary Charge
Bridge Wire
Secondary Cartridges
Dome
Pressure Transducer (Wires to Recording Instrument)
Quick-opening Exhaust Valve
6 in.
Base Ring
Deflector
Dome Retainer Ring
Sample Holder
Firing Chamber

This generator is a basic research tool for the dynamic testing of soils, metals, plastics. Material to be tested is placed in a removable sample holder, and the primary and secondary charges are electrically fired. Expanding gases create the dynamic load on the test sample. Variations in load are dependent on the number of secondary cartridges used. Developed and designed by Boynton Associates, La Canada, Calif., the load generator is in use at MIT, Univ of Texas and SRI.

Corporate R&D Thrives Near College Scholars

SAN FRANCISCO—In growth industries, nearness to source of brainpower is more important than nearness to markets, raw material, transportation or labor. This dependence of science-based industries on nearby academic stimulus was detailed by Frederick E. Terman, provost of Stanford Univ.

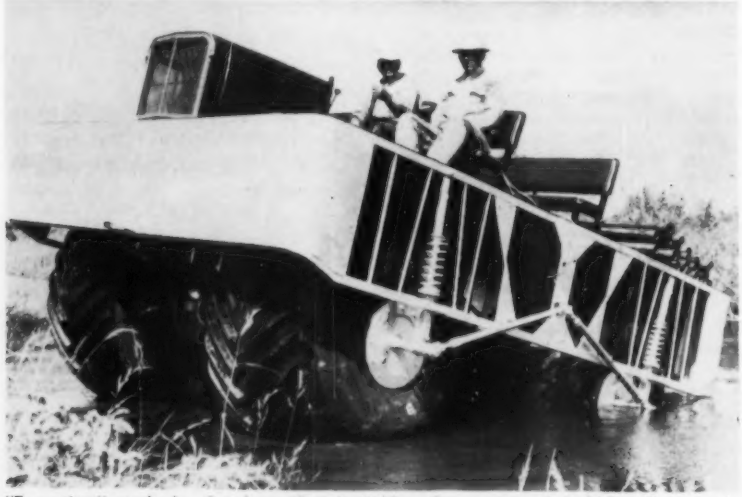
The Boston area, he pointed out may be stagnant in many respects, but is one of the liveliest places in the country for industries that are based on a rapidly advancing science and technology. Similar concentrations of industries in the missiles, electronics, chemicals, and nucleonics fields are likewise found around Caltech, Stanford and the Univ of California.

Where growth industries are too far from educational institutions he said, serious effort is often required to remedy the situation. For example, Bell Telephone Labs, in a residential area of New Jersey, has had to set up a branch campus of New York Univ right within the labs. The branch offers college credit instruction on company time.

Similarly, United Aircraft at Hartford, Conn, has an arrangement with Rensselaer Poly for a branch campus in that city (*PE*—Oct 14 '57 p 111). The school is financed entirely by Hartford industry.

Dr Terman listed five main advantages of locating industries near universities. These institutions are (1) sources of highly trained men, (2) of ideas that stimulate invention, and (3) of expert faculty consultants: (4) they also provide educational opportunities for employes, (5) an environment that stimulates creativity. ■

Tires Float 4 Tons of Vehicle



"Terra-tires" made by Goodyear Tire & Rubber Co measure 5 ft high, 42 in. wide and 18 in. at the hub; are used on Crain Bros' Model 400 marsh buggy. Selected for low flotation, increased traction and greater mobility, the tires can float the 4000-lb vehicle along with another 4000 lb in payload.

Improved Chrome Plate–Better Diecastings

DETROIT — Major improvements in chromium-plating processes will extend corrosion resistance of zinc diecastings to many times what could be expected with earlier processes, according to a report given to the automotive and appliance industries by the American Zinc Institute. The report calls introduction of the duplex nickel process the first major innovation in the copper-nickel-chromium plating sequence.

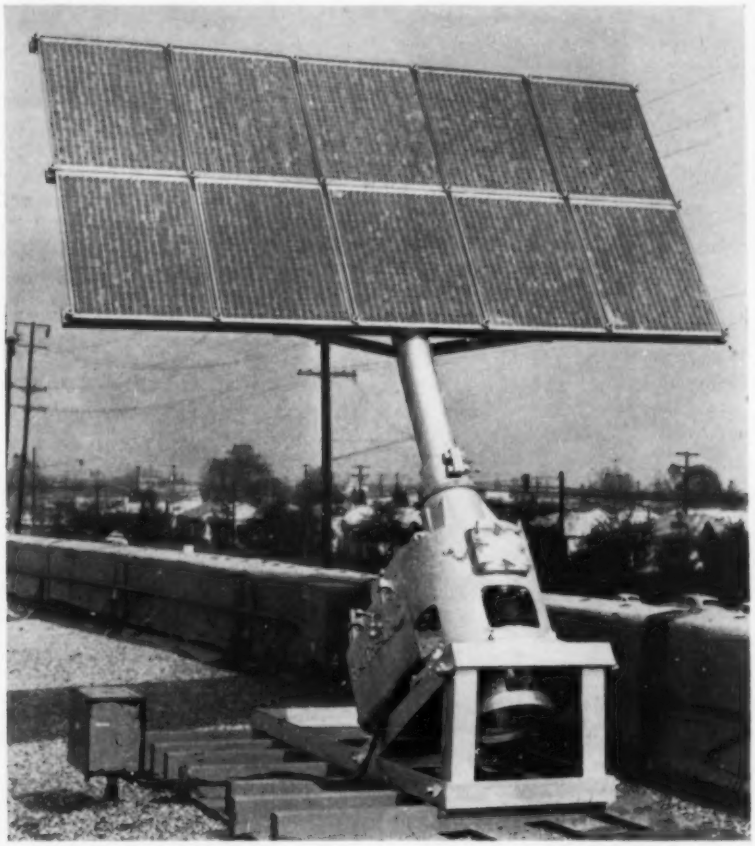
CORROSION IS SLOWED

Although the process was developed to eliminate or at least reduce buffing of nickel plate before chromium plating, it was found that duplex nickel also helps prevent corrosion of the base metal. Corrosion is markedly slowed at the nickel interface, reports M. M. Beckwith of the Harshaw Chemical Co. Duplex nickel is a double-layer combination of semibright nickel followed by fully bright nickel.

NICKEL LAYER FOR LUSTER

C. H. Sample, International Nickel Co, explains that the semibright nickel combines the corrosion resistance with excellent leveling characteristics and ductility, resulting in substantially continuous, not easily broken surface. The bright nickel layer is simply added to give high luster, so that minimum of chromium might be required. ■

'Big Bertha' Beams Solar Power

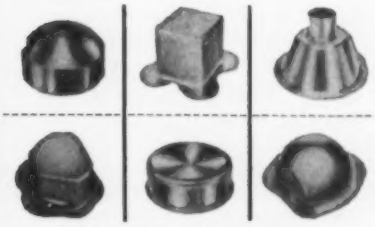


Developed by Hoffman Electronics Corp to power an array of experimental equipment (salt-to-fresh water conversion, water-pumping station, etc.) "Big Bertha" is the world's largest solar energy convertor, producing electricity through 7800 silicon solar cells mounted on a single 4 x 8-ft panel. Ten individual panels in the unit can be connected, in various series and parallel combinations, through a control device to provide outputs of from 6 to 60 volts in increments of 6 v, and current flows ranging from ½ to 5 amp in ½-amp increments. The convertor's swivel base tracks the sun automatically and keeps its face exposed for max efficiency. Any surplus energy generated is stored in batteries for use at night or on sunless days.

KAUPP
PRECISION-FORMED
METAL
COMPONENTS

Hydroforming, Deep Drawing and Spinning

You can depend on KAUPP for complete service from design to delivery on precision-made metal parts and sub-assemblies. Ultra modern metal working facilities, plus wide experience on military and commercial requirements are available to solve your problems. Send drawings for quotations or phone for new illustrated bulletins!



Closest tolerances adhered to in all metals, including MU METAL, BRASS, INCONEL, ALUMINUM, COPPER, CARBON STEEL, STAINLESS STEEL, NICKEL, MAGNESIUM, TITANIUM, SILVER, SPECIAL ALLOYS, HAYNES STELLITE.

C. B. KAUPP & SONS
Metal Craftsmen since 1924
NEWARK WAY, MAPLEWOOD, N. J.
Telephone: SOuth Orange 3-2490

Typical Control Functions solved by AIR CIRCUITRY

Westinghouse Accessory Devices

Westinghouse Air Brake Company manufactures a complete line of accessory air devices, in addition to basic devices that use air only to extend or retract cylinder rods. These devices, functioning between the primary sender and final positioner, control air flow and pressure to provide the most complex sequences of operation. Their design, however, is not complex. The few wearing parts, if any, can be replaced by any reliable mechanic.

Westinghouse accessory devices in addition to many types of air directional and pressure control valves, positioners and piping equipment makes available to you one source for a full line of everything you need to install and operate an efficient air circuit. For more information ask for Catalog DO-00-2.

APPLICATIONS—The illustrated devices in conjunction with other air circuit components have been used successfully by all types of industry. Manufacturing processes, marine equipment, drilling operations, construction machinery and transportation facilities have all enjoyed the benefits of Westinghouse Pneumatic Controls. We will be glad to demonstrate how you too can benefit.

What is Air Circuitry?

This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise AIR CIRCUITRY is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will help you boost production and cut costs in your plant or shop.

1. QUICK RELEASE—Remotely operated vent valves permit quicker operation for release of cylinders, clutches, brakes, etc. The Quick Release Valve provides a large exhaust port as close as practical to the air volume to be vented instead of back through the controlling device.

2. PRESSURE RELAY—Large quantities of air are relayed or repeated by the Relay Valve at pressures corresponding to the control pressures applied to them. The Relay Valve increases the speed of operation and reduces transmission times in long control lines.

3. CIRCUIT SEGREGATION—The Double Check Valve connects two segregated lines to a common third line and still maintains the segregation. Air flowing from one line to the common line seals off the unused line by means of an internal shuttle. Controlling a single operation from two or more stations is an example.

4. TIMING—The Westinghouse Floreg Valve is an adjustable device that controls the rate at which air can flow in one direction through the circuit, yet allows free flow in the opposite direction. It is used to time, synchronize or co-ordinate the operations of a circuit.

5. INTERLOCK—To insure one function is performed and conditions are satisfactory before another function is initiated, the H-5 RELAYAIR® Valve may be used. A pilot operated, directional control valve with various spring settings, this device requires a prescribed pressure be present in its control chamber before it operates.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY

INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

More Profs with PhDs Sought by Stanford

PALO ALTO, CALIF.—More engineering teachers with Ph D degrees are expected to result from a $200,000 Ford Foundation grant to Stanford Univ.

According to Joseph H. Pettit, dean of Stanford's school of engineering, $100,000 of the grant will be used for pre-doctoral fellowships and tuition loans. Doctoral candidates will be given a $3000 tuition maximum for a full year, or $2300 if the student chooses summer employment instead.

Another $75,000 will be applied to faculty development at Stanford while the remaining $25,000 will go for faculty development at other institutions. This may allow for specialists to be invited as visiting lecturers and to send promising young Stanford faculty members to do research or participate in engineering programs at other universities.

Post-doctoral fellowship training for younger facutly members of other institutions is planned as a faculty-exchange program with other engineering schools. Also available will be a "forgivable" loan of $3000 to students (forgiven at the rate of $600 a year) providing the student pursues a college teaching career. ■

Italy Claims Continuous Rotary Plastic Welder

MILAN, ITALY—What is claimed as the first continuous, rotary plastic welding machine has been produced by Gaico Co in Turin. According to representatives of Gaico, the machine is capable of uninterrupted, infinite length, straight, curved or out-of-plane welding ability allowing an output of up to 10,000 pieces per hr at minimum cost.

Principle of the machine is not new as welding results from passage of induced current from an electrode, shaped at will and pressing on the parts to be welded, to a fixed counter electrode. Welding material is polyvinyl chloride. Other materials can be used if electronic circuit or frequency is varied.

Hourly production of the machine is a function of the speed and of the dimensions of the pieces to be welded. The machine can cut and weld simultaneously 2 x 1 m pieces requiring no

increase in power. Properly equipped, it can also weld containers of any shape. Gaico says the welder replaces 7 to 10 conventional welders and operators. ■

Synthetic Diamond Production Upped

NEW YORK—A method of producing synthetic diamonds for industrial use has been developed by DeBeers Consolidated Mines in Johannesburg, South Africa. The diamonds will be similar to synthetic diamonds produced by GE (*PE—Nov 23, p 41*).

Having already applied for patents, DeBeers reports that it is now technically and economically feasible to proceed with the manufacture of synthetic diamonds if a decision in the matter can be reached with the Belgian Congo Diamond Mining Co which produces most of the world's quality diamonds.

DeBeers says also that the abrasive grit is suitable for resin-bonded grinding wheels, the only field in which synthetic diamonds have been competitive with natural diamonds. ■

Point-source Gamma-ray Standards Issued

WASHINGTON—The National Bureau of Standards is making available for the first time point-source standards of radioactivity. These standards are gamma-ray emitters and will useful to research workers in approximating "ideal" conditions when calibrating scintillation counters and other beam-detecting devices.

Five of these standards are being issued under the NBS program to supply standards in all areas of the physical sciences. The five are: sodium-22, zinc-65, niobium-95, strontium-85, and mercury-203. Each standard consists of radioactive material deposited between two layers of thin polyester tape. ■

Radio Altimeter Undergoing FAA Tests

WASHINGTON—The Federal Aviation Agency is conducting tests on a new British altimeter so precise that it is reportedly accurate within a few ft. The instrument, unlike those now in use, is a radio altimeter, using frequency modulation. ■

You can take it for granted . . . because we don't
You've met the one-call salesman. Sells you a product that seems to do the job but is nowhere to be found when you need service and advice. Not dishonest—just disinterested. He closed the sale—period.
With AMP, however, the sale is just the beginning. Our product is a complete program for terminating electrical circuits—not boxes of electrical terminals. That's why we keep coming back: to make sure you're getting the most efficient use from our technique and products, to make sure your total installed costs are the lowest possible and your circuit reliability is the highest.
As an AMP customer, you'll be able to call on the services of many AMP specialists—the District Sales Engineer, the Field Service Engineer, Product Improvement and Quality Control Engineers, Audio-Visual Training Engineers, and the Mobile Wiring Laboratory Product Demonstration and Operator Training Team.
You can take this service for granted because, unlike the one-call salesman, we never close a sale.

Write for more information on our electrical wire terminating program.

AMP INCORPORATED

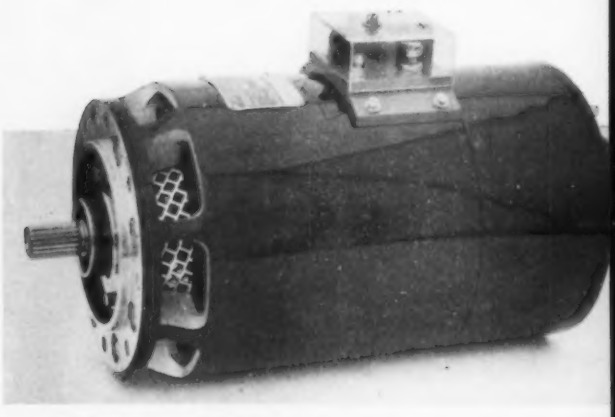
General Offices: Harrisburg, Pennsylvania

A-MP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Japan

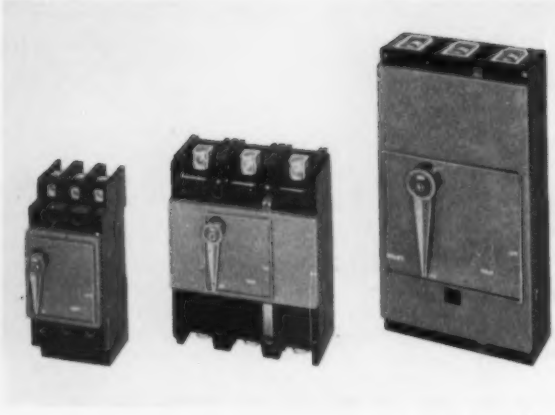
CIRCLE 29 ON READER SERVICE CARD

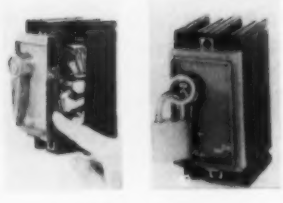
TRENDS|*in appearance design . . .*

Chest-high automatic drill-pointing machine uses cam-based movement to point helical or any other conventional type of drill. Drills (0.032 to 1 in. dia) are held in hydraulically operated workheads (circular element in rectangular top plate). Rate of feed, rate of material removal, automatic wheel dressing, on-off switches and other controls are located on knee-high control panel. Housing manages, with minimum surface and detailing, completely to enclose grinding wheel and retain coolant spray and chips. By Winslow Product Engineering Corp, Arcadia, Calif



Forged shell and flange-endbell of this brushless ac generator are machined and painted to provide circumferential vents that become integral with over-all design. Removable open-end plastic cover provides adequate protection for terminal plate without adding bulk. Delivers 9 kw, 30 v dc over 5000 to 8000-rpm speed range; weighs 30 lb. By English Electric Co Ltd, London, England.





Rotary handle in this line of circuit breakers is finished to contrast with clearly delineated, completely plain background, so that handle also indicates by position whether mechanism is on, off or tripped. Handle hub also incorporates key-type lock and locking ring capable of accommodating up to three padlocks at once. Breakers are made—in a series that will handle from 15 to 800 amp, 480 to 600 v—by Federal Pacific Electric Co. Styled by Raymond Loewy Associates, New York.

Some of the newer trends in European car design

Facellia, top left, a two-place, 114-mph, 5-cyl, 1600-cc sports car, will also be available with a larger engine using an electronic ignition system. By Facel Vega of France, this car combines a number of classic approaches to automotive design into a unified look that avoids the Detroit styling only too prevalent in many current European models. To avoid developing a special version of its unusual looking DS19 sedan for export to hot climates, Citroen (top, right) has added air intakes on upper inside edge of both front fenders (beside model's left hand). With this goes a change in carburetion—inlet passages integral with the head. The "Delorex" (center, left), is a new small Czechoslovak car with a 2-cyl, two-stroke, aircooled motorcycle engine that develops 22 hp at 5,200 rpm. Designed specially for use by invalids, glass-fiber laminated body has simple enough lines but, as with some American cars, vents both front and rear leave open the question: Where is the motor? Citroen 2CV, (center, right) has a special body designed by Francis Clauzet and made of steel sheet bent and welded together to achieve knife-edge styling more like that of tank than old-style coachwork. This body costs more ($1100) than production version of the car on whose chassis it's fitted. It is the rear of the Italian designer Ghia's new sedan body that you are looking at (bottom, left). Front doors and forward seats are positioned entirely ahead of front axle. Driver's wheel, shaped like air pilot's control stick, is switchable for right or left-hand drive, and dual foot controls are provided; other controls on center pedestal. Refreshing as this car is in rearranging some of basic auto elements, it still draws heavily on Detroit for body modeling and decoration.

HOW GOOD ARE ENGINEERING APTITUDE TESTS?

We put this question to several testing agencies and personnel departments of large corporations. Here's a distillation of their experience, what the tests are like, and some warnings to the unwary.

C J Lynch, *assistant editor*

■ One way to put all personnel managers out of work is to develop the perfect pre-employment test.

They're not worried—quite the contrary, personnel managers are the most enthusiastic patrons of psychological tests. Constantly hopeful, usually disappointed, they encourage the psychologists to try and try again, and progress is being made.

While still far from a strictly mechanical filtration procedure, the science of mental measurement has come a long way in the last few years. A complete spectrum of tests has been developed—interest, personality, ability—and aptitude tests evaluate only a part of a man's personality. Job suitability, for the man as well as his employer, is made up of so many disparate factors that only the complete battery of tests, supplemented with job histories and personal interviews, can do a significant job of discriminating among applicants.

What they measure

Aptitude, achievement and IQ tests are commonly lumped together as "ability" tests. There is really little distinction between an aptitude test and an achievement test—the name depends largely on how it is applied. A test intended to measure achievement in algebra could be an excellent predictor of success in trigonometry. Ability tests can accurately measure what a man knows and how well he is able to apply it.

Interest and personality inventories are usually less accurate. Interest tests try to find how a man prefers to spend his time by asking such questions as, "Would you rather design a computer or give a speech on how computers are changing business operations?" Results are usually tabulated to show comparative interest in mechanical, computational, artistic, persuasive areas. Two popular interest inventories are the Kuder Preference Record and the Strong Vocational Interest Blank. Personality tests are intended to measure such traits as objectivity, agreeableness, energy level, social leadership, cheerfulness, emotional stability. They ask you to give an honest accounting of yourself: "Have you enjoyed reading books as much as having company in?" or "Do you prefer short men to tall men?" These tests, to a certain extent, measure how well a man will fit in with the organization. Two well-known examples are the Bernreuter Personality Inventory and the Thurstone Temperament Schedule.

For engineers, among the most common ability tests are the Revised Minnesota Paper Form Board (a test of spatial visualization), the Bennett Test of Mechanical Comprehension, and Minnesota Engineering Analogies Test. (Some examples shown in box at right.) The problem is that ability tests alone are not sufficient to pick suitable new employes:

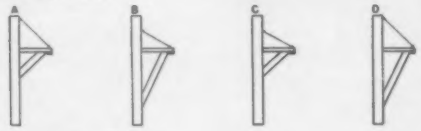
"Engineers as a group are a pretty bright bunch of guys and will do pretty well on almost any ability test you throw at them," says the director of one NY testing center. Engineers represent a preselected group, and their scores on most ability tests will cluster close to the top of the scale with very little spread. Such tests are statistically difficult to analyze and generally more useful in rejecting a poor applicant than identifying an outstanding one.

And what if a man has the ability, but not the interest or motivation for the work? What an employe can do and what he will do may be very different. Some differences may be uncovered with the personality and interest tests; others come out in interviews or by inspection of the man's biographical record. Most companies put a great deal of weight on the interviews. Keith R. Jewell, consulting psychologist for management consultants George Fry & Associates, in Chicago says, "We don't throw the test results out, certainly, but we always

Typical aptitude-test problems

Sample Problems

X. Through which quarter turn is the most power applied to the flywheel?
(If no difference, mark E.)



Y. Which shelf will hold the heaviest weight?
(If no difference, mark E.)

Reprinted, courtesy The Psychological Corp, NY

Mechanical comprehension test

Several forms are available, representing varying levels of complexity. They measure a person's ability to understand physical and mechanical relationships. Samples below are from a 60-question test written by psychologists Owen and Bennett, published by The Psychological Corp.

Although sometimes given to graduate engineers, the test is intended for candidates for engineering school and adult men of similar ability.

Engineering analogies

One of the most difficult and zealously guarded aptitude tests for engineers is the Minnesota Engineering Analogies Test (MEAT). To protect integrity of this test, it is distributed, through a licensing agreement, only to authorized testing agencies. In some places even the test administrators are barred from seeing what's inside the test booklet. All scores are reported to and kept on file by The Psychological Corp, publisher of the test.

Typical "ratio" problems are:

1. Add : subtract : : multiply : (a) integrate, (b) divide, (c) magnify, (d) differentiate
2. In a triode,
   Spectators : turnstile : : plate current :
   (a) cathode, (b) plate, (c) anode, (d) grid
3. Rate of fluid flow : electric current : : pipe friction :
   (a) electromotive force, (b) electrical resistance, (c) electrical conductance, (d) resistivity

The test measures the engineer's knowledge of subject matter and reasoning ability. MEAT therefore shows not only what he knows, but how well he is able to apply it. It is sensitive enough to discriminate between proficiency differences of high-ability graduate engineers.

Verbal reasoning

A number of intelligence tests require the subject to draw conclusions from a series of stated facts. The example below was taken from a sample problem in a 10-part battery of employment tests published by Psychological Services Inc, Los Angeles. This part of the battery includes six such problems to be worked in five minutes.

FACTS Chris is a widow
Jane works for Co B
Chris' only child is a girl
Co A makes spark plugs
Co A employs no women

CONCLUSIONS (true, false or unknown?)

1. Chris does not work for Co A
2. Chris' son is ill
3. Chris works for Co C
4. Chris has never been married
5. Chris inspects spark plugs

Answers, page 4

temper them with good penetrating interviews. Testing of engineers can be oversold–sometimes it is mostly guesswork or statistics, and people aren't numbers."

Who uses tests and for what?

It is estimated that over 70% of industrial concerns, both small and large, use psychological tests in some phase of their personnel work. Small firms may have their testing done by an outside agency or college testing center. Large outfits ordinarily have their own personnel office and a resident psychologist. Six large corporations–American Telephone and Telegraph, Detroit Edison, B F Goodrich, IBM, Sandia Corporation, Westinghouse Electric–in cooperation with Educational Testing Service, Princeton, NJ, have recently begun a research program to develop tests that discriminate between engineers that are likely to be successful in certain phases of engineering work and those that are not. To date, findings indicate that interest tests are most effective discriminators for engineers with 4 to 7 years' experience. Aptitude tests rank second and are particularly helpful in spotting ability in abstract reasoning.

In addition to tests for employe selection, industry uses them to upgrade present employes, appraise executives and evaluate would-be executives. The engineer often finds the tests valuable in planning his own future or selecting new job opportunities. Some job-hunters take aptitude tests at their own expense and have the results sent from the testing center to prospective employers.

Can they reduce "break-in" time?

In almost all instances, yes. With tests, the number of potential misfits is reduced–those accepted are less expensive to train and more likely to stay with the job. Of course, this must be balanced against the testing

HOW GOOD ARE ENGINEERING APTITUDE TESTS?

Even Logic Is Measured . . . by Pushbutton

One of the newest and most sophisticated aptitude tests is the Logical Analysis Device (LAD) originally conceived by a group of psychologists at the University of Chicago and now under development at The Psychological Corp, New York. It is a puzzle that tests a person's ability to work through a series of cause-and-effect relationships to a logical conclusion. (Photo at right shows the machine like.)

Psychologists learned one thing about it while it was still in the working-model stage: it scares away sales engineers pronto. Well over a dozen salesmen for electronic components came to call when LAD was being developed. Curious about what psychologists wanted with electronic parts, they were shown the working model and permitted to give it a whirl. Almost without fail, each salesman, after fooling with the buttons and lights for two or three minutes, remembered he had his car double-parked or had an important luncheon engagement.

Although LAD will predict success in several kinds of jobs that require analytical ability, psychologists admit they don't know exactly what it measures. There is very little correlation between LAD scores and IQ scores . . . or any other measurable ability. LAD stumps some PhDs, yet highschool students sometimes breeze through problems with relatively little difficulty.

The problems are unambiguous, completely defined logic systems with no tricks, no secrets. They require no specialized experience or knowledge. Problems and level of complexity can be changed by simply substituting a new problem disk and plugging in a different printed-circuit module.

What it proves

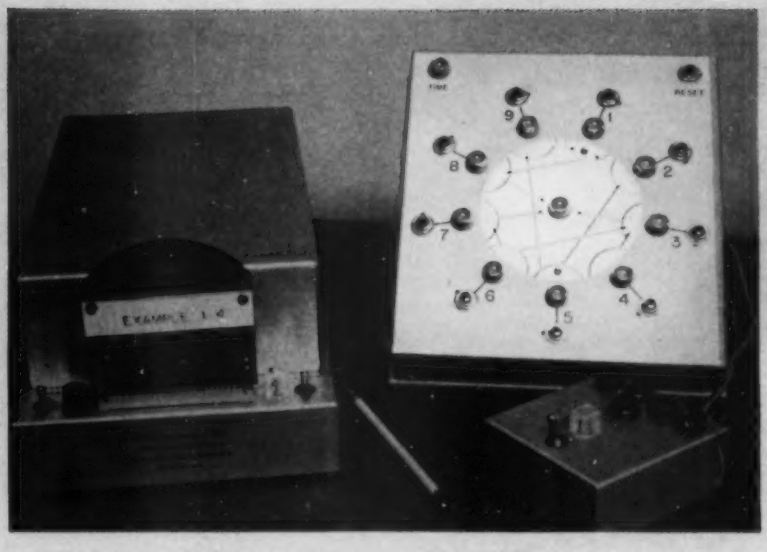
Perhaps the most significant results from LAD tests have been in selecting computer programmers (this is also the area where the most data have been obtained). In a test of four groups of programmers, comparing LAD scores with programming ability gave correlations that varied between 0.50 and 0.88. There has been less experience with tests on engineers but one experiment shows promise in this area: A large industrial firm divided 18 of its engineers into two groups—9 "thinkers" and 9 "doers." With LAD scores, psychologists correctly identified 14 of the group and judged the other four about equally adept at thinking or doing. There is also some evidence that LAD tests will help identify troubleshooters and service personnel where the job requires locating a hard-to-find malfunction or detecting the unseen cause of a malfunction.

Test procedures are standardized so that comparative results are meaningful. The subject is allowed about 15 minutes to become familiar with the rules of the game and the usual modes of attack. During this time the examiner shows simple examples and answers questions. Following the introduction, the subject is given a problem and allowed to work in isolation in any manner he pleases. All his moves and the passage of time are automatically recorded.

Speed in solving a problem tells less about a subject than the way he solves it. Some subjects work slowly and deliberately—others are perplexed by the complexity, push buttons recklessly without stopping to note the effect, keep the lights in a continuous dance around the circle (called "organ playing" by the psychologists). Some subjects are able to solve a small segment of the problem but don't know what to do next. Lost and without much exploratory urge, they verify and reverify the sub-routine, sometimes as many as 6 or 7 times.

For the most part, subjects use the methods they were taught during the instruction period. Only a very few highly analytical persons are able to come to a solution by setting up rather complicated and sophisticated experiments that give them several bits of information in one step.

Because LAD measures abilities that seem to have very little correlation with other easily circumscribed abilities and because it gives, for the first time, a permanent record of a person's speed and methods of solving logic problems, psychologists have hope that ultimately the machine will measure some new psychological dimensions.



Nine lights and buttons . . . are all that the LAD problem-solver has to work with. Light in upper left-hand corner of board flashes off and on at 3-sec intervals to indicate which of two time-periods is in effect. Arrows on problem disk show relationships between lights. If light at tail of arrow is lit (controlled by its adjacent button) it will have one of three logical effects (AND, OR, or NOT) on light at head of arrow in the following time-period. Object of the game is to identify all logical relationships and eventually control center lamp, using only the three buttons numbered 4, 5, and 6. Control is provided by box of electronics gear at left and plug-in module (marked, EXAMPLE 1-4). Small box is examiner's control unit.

costs—if requirements are strict, too many men may have to be tested to get the desired number of acceptable employes.

The tests themselves are inexpensive, ranging from a few cents to slightly more than a dollar for test booklet, answer sheet and instructions. Interpretation and administration are the costly factors. A battery of tests given and analyzed by a testing service will usually cost between $50 and $200, including a conference with the candidate.

Are engineers scared away by tests?

Some firms believe that no good engineer will put up with any kind of pre-employment test. Others take the opposite stand, feeling that good engineers will appreciate knowing the company is selective in hiring new talent. This selectivity, reasons the engineer, will raise the intellectual environment and increase the opportunity for technical development. Which side of the fence you're on depends largely on what kind of engineers, and how many, you hope to hire.

Do scores correlate with performance?

This depends on whether the tests are properly applied and the scores intelligently interpreted. A high score in a test for finger dexterity does not predict a man's executive ability. The best way to develop a valid test for a particular job is to test incoming employes and accept them regardless of their score. Several years later, when performance data are available, these tests can be correlated with on-the-job performance. Valid tests can then be given to new applicants for that job. Good tests are usually custom-built for the job this way.

For the most part, users are satisfied with the results. A West Coast machinery manufacturer says, "We have been using tests for about three years now and would say that they are batting 80 to 90% correct. In fact, we can think of only two misses out of about a hundred —and one of these would have worked out quite well except that he was trying to make a business out of his hobby and was putting in too many outside hours.

"On the other hand," he continued, ". . . they have saved us from several bad hires—people we were considering for rather high-level positions on the basis of good records and high recommendations, but whose job histories elsewhere were unfortunate. Also, on the few occasions where we have ignored our psychologist's advice, we have invariably regretted it."

Success of the tests is best shown by the large number of firms now using the tests and confidence they have in them. At Newark College of Engineering, where all seniors are tested and counseled, studies five years after graduation show that over 70% of the graduates are satisfied with their choice and have remained with the firm they started with. Compare this with the 50% all-industry average for engineers who stick with their original choice.

A psychologist for Illinois Institute of Technology puts it this way: "Testing is indeed a device for fitting a man into a job better than it can be done without tests. But you must select the proper test for the job." ■

For a REPRINT of this article, check P 23 on Reader Service Card.

To set up a testing facility

Best place to start is with a local testing center. Engineering schools may have an agency that conducts tests for industry—or they will be able to direct you to a consulting firm that does. The classified section of the phone book lists testing firms under Personnel Analysis. Two authoritative books also list accredited testing agencies. They are:

Directory of American Psychological Services—1960 American Board for Psychological Services, Glendale, Ohio.

1958–1960 Directory of Counseling Agencies, American Personnel and Guidance Association, 1605 New Hampshire Ave, Washington 9, DC.

Many tests are available directly from test publishers. Some can be purchased by any industrial organization; others are restricted to firms that employ a full-time experienced psychologist. If you want to buy a group of tests, consider the following factors:

Beware of firms that interpret scores by mail. Any good testing organization will require a personal interview with the candidate before making a recommendation.

Don't judge a test by the title—it may not measure the factors you're trying to pin down. Even though a personality inventory may be readily available to anyone who wants to buy it, it should be interpreted by a trained psychologist. The common-sense approach can lead to trouble: the best test for typing aptitude, for example, is not a finger dexterity test but a spelling test.

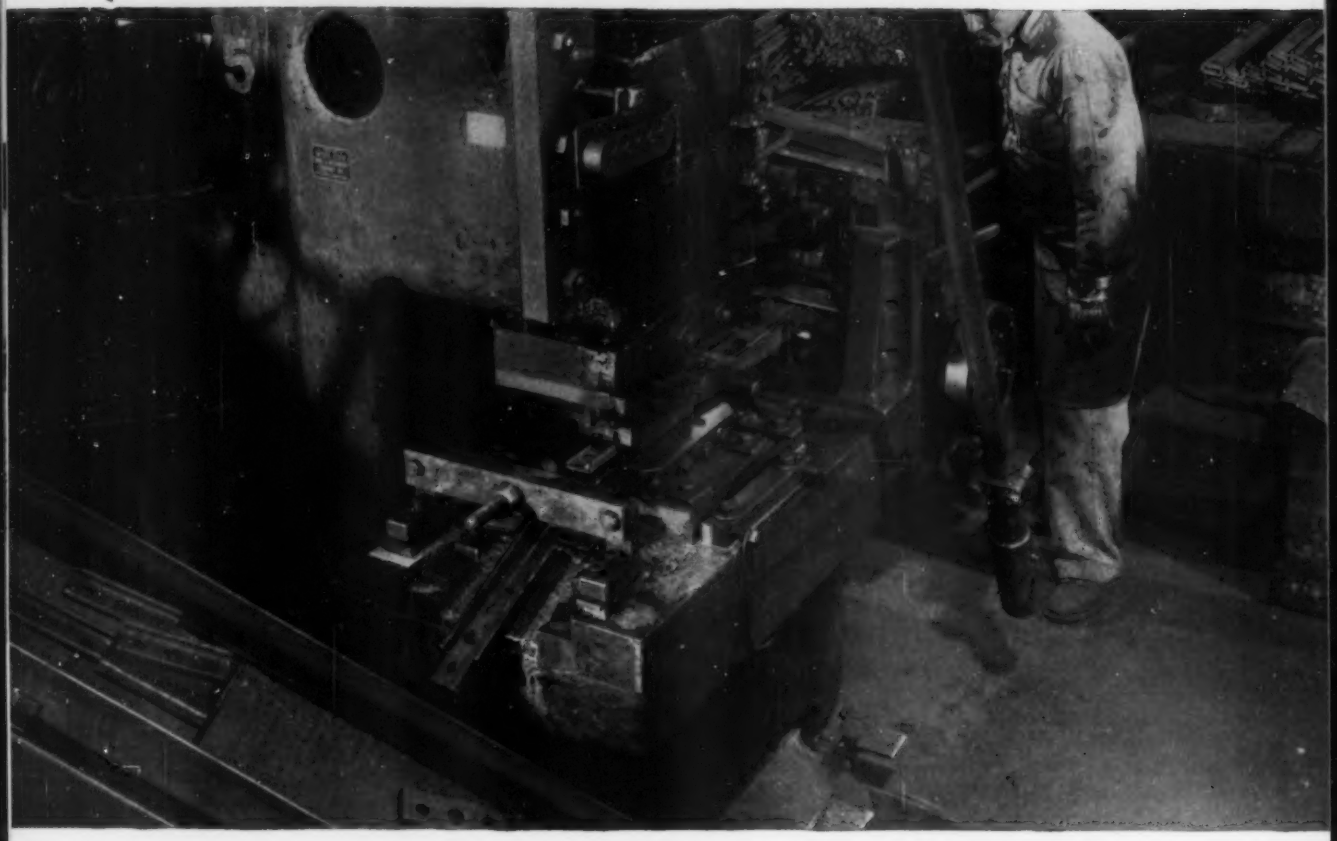
Beware of tests that make extravagant claims. Most good tests have been prepared by professional industrial psychologists listed in the Directory of American Psychological Association. Critical reviews of almost all tests will be found in "Mental Measurements Yearbooks" edited by O. K. Buros and published by Gryphon Press, 220 Montgomery St, Highland Park, NJ.

Watch out for claims based on a group that bears little resemblance to the people you want to test. A test that is valid for one group is not necessarily valid for another.

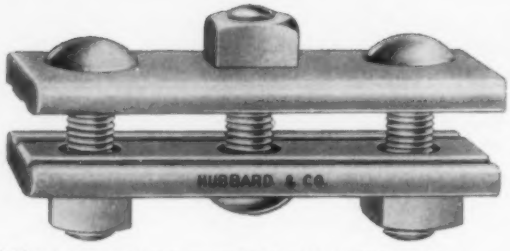
Here is a partial list of test publishers from whom catalogs are available.

Acorn Publishing Co Inc, Rockville Centre, NY
Bobbs Merrill Co Inc, 1720 E. 38 St, Indianapolis 6, Indiana
California Test Bureau, 5916 Hollywood Blvd, Los Angeles 28
Center for Psychological Service, George Washington Univ, Washington, DC
Cooperative Test Division, Educational Testing Service, 20 Nassau St, Princeton, NJ
Educational Test Bureau, Educational Publishers Inc, 720 Washington Ave, SE, Minneapolis 14
Houghton Mifflin Co, 2 Park St, Boston 7
The Psychological Corp, 304 East 45th St, New York 17
Psychological Services Inc, 909 West Jefferson Blvd, Los Angeles 7
Science Research Associates Inc, 57 West Grand Ave, Chicago 10
Sheridan Supply Co, PO Box 837, Beverly Hills, Calif
Stanford Univ Press, Stanford, Calif
C H Stoelting Co, 424 N Homan Ave, Chicago 24
Western Psychological Services, 10655 Santa Monica Blvd, Los Angeles 25

STEEL SHAPED TO CUT COSTS AND IMPROVE PRODUCTS



One automatic operation punches three holes and shears off the part from a USS Hot-Rolled Special Section. No machining necessary.



Hubbard pole line hardware made from USS Special Sections.

Pole line hardware • one punch • made from USS Special Sections

Hubbard and Company is one of the largest pole line hardware manufacturers in this country. They turn out guy clamps, cable suspension clamps and lashing clamps by the thousands. To keep production costs low, they use USS Special Sections already rolled to the proper cross section for the finished piece.

Many items can be punched and sheared in one automatic operation so that there is no machining and very little scrap. Parts can then be galvanized, bolts inserted and the job completed.

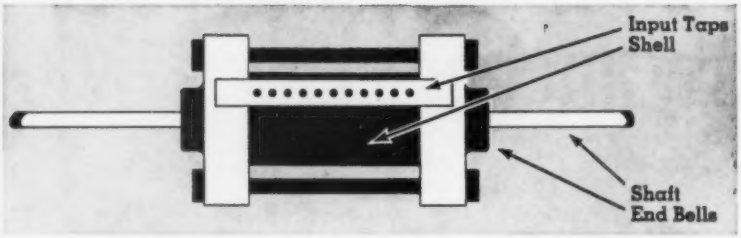
How USS Special Sections can reduce your costs. If you have an irregular steel part that must be produced in quantity at low cost, let us check your drawings. Many times a complex and costly assembly can be replaced by the use of one USS Hot-Rolled Special Section. Designs are unlimited. Write for our new book showing many intricate shapes already being produced. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

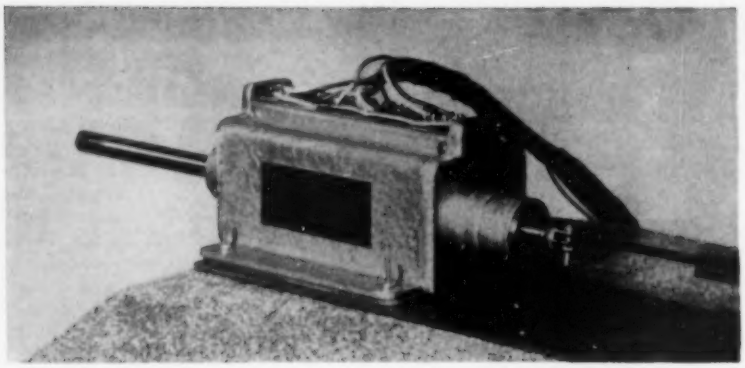
USS is a registered trademark

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company

United States Steel

SIGNIFICANT COMPONENTS MATERIALS PROCESSES





Linear positioning motor . . . responds to input with linear shaft movement to any of several accurate positions, determined and selected by input devices such as switches, relays, pushbuttons, contacts or more complex digital inputs. Shaft of linear positioning motor moves to proper position in one motion, uninterrupted by intermediate reference points, stops or ratchets. Repeatability within 0.005 in., travel times of 100 millisec and thrusts of 100 lb or more are said to be possible. Shaft, only moving part, moves in linear direction only, though shaft is free to rotate with attached load, if necesary. Shaft can be rotated at any time and may be mechanically moved axially when motor is not energized. When energized, shaft is magnetically held in definite axial position. Can be used with potentiometer or decade resistance box for fine positioning. Operates on 115 v dc max, continuous duty; 300 v dc max, intermittent duty. Motors can be designed with variations of size, shape, thrust, speed, accuracy and number of positions. Model B1002, with 27 positions and repeatability of 0.003 in., is $49 each in sample quantities; other models, from $24. All FOB Minneapolis. Delivery, 30 days. **Tronics Corp, 3324 Hiawatha Ave, Minneapolis 6.**

CIRCLE 101 ON READER SERVICE CARD

Analog-to-digital converter with memory . . . utilizes no electronic components between output and accessory readout equipment. Electromechanical device converts analog inputs to any desired digital code with readout rate of 2 per sec continuous. Contains integral input shaft and first stage code drum, to which additional drums are geared. Each drum is composed of concentric cams, profiled with high, intermediate and low faces. Solenoid-operated sensors, each with position-locking device, sense drum profile and close either of two switches in high or low position. Readout time is 0.050 sec. By use of cam and follower assembly, transition from one drum to another is sharply defined in either direction. One-drum unit has breakaway torque of 0.003 in.-oz; two-drum unit, 0.004 in.-oz; three-drum unit, 0.004+ in.-oz. Typically, two-drum unit with case weighs 5 lb. 12 output codes allow direct application, including linearization where necessary, for thermocouple, time, level, weight, flow, rotation, pressure and position readouts. **Telechrome Mfg Corp, Automation Div, 26 Edison St, Amityville, NY.**

CIRCLE 102 ON READER SERVICE CARD

High-accuracy stepping motor is said to be capable of developing three times greater torque minimum than comparable devices. 1½ in. motor is used to rotate potentiometers, counters, rotary switches, tape advances and control mechanisms. Special clutch mechanism replaces ratchets, permitting translation of pulses to incremental shaft positions with reported accuracy of 99.9999%. Each unit is pretested over 50,000 steps in each direction. Available in unidirectional and bidirectional models, ranging from 4 to 13 oz, with angular increments of 36° per pulse, up to 15 steps per sec, and load capacity up to 2 in.-lb starting torque. Brakes at end of each step. Bidirectional units have two separate coils. **G H. Leland Inc, 123 Webster St, Dayton 2, Ohio.**

CIRCLE 103 ON READER SERVICE CARD

Perforated zippered tubing . . . permits branchouts for wire harness assemblies. May also be used as a raceway instead of clamps, ties or lacing. Allows drainage of moisture condensation. Perforations are spaced so that wires can be snaked out wherever desired. Available in general purpose and military types. Immediate delivery. **Zippertubing Co, 752 S San Pedro St, Los Angeles.**

CIRCLE 104 ON READER SERVICE CARD

Webster was right! Rectify means make right

that's just what *built-in rectification* does for PIC Counters—*makes alternating current right* for efficient, reliable operation over a tremendous count life.

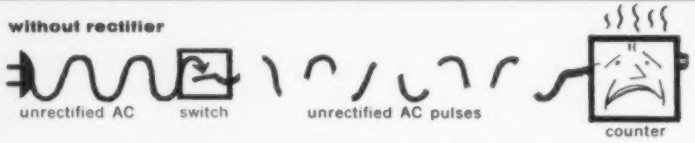
PIC-600 Electric Counter
50 million count life

CE-800 Electric Counter
200 million count life

When operating PIC-600 or CE-800 Counters from AC you get the long recognized advantages of DC operation *without adding any circuitry or components.*

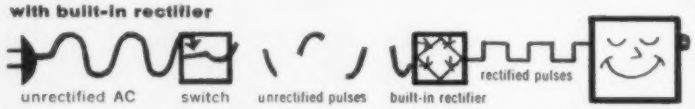
You can hear the difference. Ask your PIC Distributor or Representative for a demonstration or write us.

without rectifier



Pulses from unrectified AC vary greatly. The stronger pulses pound the counter, cause heating and fatigue, soon make the counter ready for the "final count". Excessive voltage increases destructive pounding and further reduces count life.

with built-in rectifier



The rectifier converts the erratic AC pulses to uniform DC pulses. Pounding, noise and needless heating are avoided. AC hum is eliminated. Count life is more than doubled. The range of permissible excess voltage is widened.

PIC G C

Manufacturers of Counters, Switches, Relays, Actuators and Automatic Valves

AUTOMATION CONTROLS DIVISION

GENERAL CONTROLS CO.

8072 McCormick Boulevard, Skokie, Illinois

Representatives and Distributors in Principal Cities of United States and Canada

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Photoelectric control . . . maintains closed circuit only when photoelectric current is not less than 7 and not more than 8 milliamp. Loss of emission, filament burnout, lamp failure, shorting within a tube or a defective component ordinarily results in too little or too much current. Safety action is obtained by use of two light-energized plate relays connected in series so that when contacts of either relay are open, circuit is open. Relay contacts are rated 8 amp at 115 v ac, noninductive load. Standard units operate from 115 or 230 v, 50 or 60 cps. **Autotron Inc, Box 722Y, Danville, Ohio.**

Circle 105 on Reader Service Card

High-torque fastener . . . can be driven tightly without reaming out off-set recess. Utilizes lubricated O-ring method of sealing. Thin Teflon washer between O-ring and screw head eliminates bunching or cutting of O-ring. **Aero Bolt & Screw Co Inc, 1071 W Arbor Vitae, Inglewood, Calif.**

Circle 106 on Reader Service Card

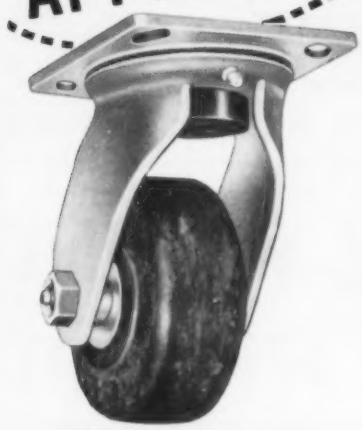
Extruded nylon film . . . and sheet is offered in thicknesses from 0.002 to 0.060 in. and widths to 18 in. Available in unlimited lengths, suitable for mass production stamping of thrust bearings, electric insulators, oil bearing items, and backup rings. **United States Gasket Co, Camden 1, NJ.**

Circle 107 on Reader Service Card

Solid-state photorelay . . . operates standard relays or solenoid-actuated devices (with coil resistance of about 2200 to 2800 ohm, max current 50 milliamp at 115 v ac), wired in series. Sensing element is cadmium sulfide cell. Has threaded mounting hub for ¾ in. conduit. List price, $10. **Berkeley/Dynamics, 2831 7th St, Berkeley, Calif.**

Circle 108 on Reader Service Card

APPROVED



COMPLETELY SEALED
MAINTENANCE-FREE

SANITARY CASTERS

Another *first* for better equipment sanitation! A complete line of sealed, sanitary casters in light, medium and heavy-duty models that comply . . . and surpass even the most rigid sanitation standards.

New in design, with special construction-convenience features that make sanitary maintenance simple and easy; plus the fact that they outlast regular casters many times over.

Immediately available in a broad range of floor-protective swivel and rigid models in 4″, 5″ and 6″ wheel diameters, 400 to 1200 pound capacities.

Molded Texite Wheels . . . were selected for use on these sanitary casters because they offer better floor protection, equal semi-steel wheels in load-handling abilities, are easily cleaned, shock resistant and impervious to most industrial chemicals, acids, etc.

Write Today . . . for additional information, specifications, prices on these modern sanitary casters.

ALBION INDUSTRIES, INC.

Distributors in Every Strategic City

Main Plant
ALBION, MICHIGAN

Quick disconnect valves . . . are offered in low-pressure (500 psi max) and high-pressure (3000 psi) series in aluminum and stainless steel. Both halves are self-sealing. Said to permit no fluid spillage, no trapped air. Synthetics Inc, 3100 Airport Ave, Santa Monica, Calif.

Circle 109 on Reader Service Card

Hydraulic in-line filter . . . for pressure or suction side of pump has three ports, two in and one out. For operating pressures to 150 psi max. Available with sintered metal or wire cloth filter element, for 1¼ and 1½ in. pipe sizes. Tools Inc, 1927 S Kostner Ave, Chicago.

Circle 110 on Reader Service Card

Sealed bearing for abrasive . . . environments said to have a dynamic capacity of 13,400 lb. Bearing has 21 crowned rollers, an ID of 1.75 in. and a spherical OD of 3.3465 in. Buna-N, steel-backed, rubber-bonded seal prevents dirt, dust and chaff from abrasive action on rollers and races. Developed as a special self-lubricating bearing for farm equipment application. Rollway Bearing Co Inc, 541 Seymour St, Syracuse, NY.

Circle 111 on Reader Service Card

Silicon power rectifier . . . provides up to 240 amp of forward current per cell with max peak inverse voltage ratings up to 600 v. Max reverse leakage current is 50 milliamp at rated peak inverse voltage. Operates at ambient temperatures to 374 F at junction. Max cell length is 3 in.; over-all weight, 8 oz. Westinghouse Electric Corp, PO Box 2088, Pittsburgh 30.

Circle 112 on Reader Service Card

White epoxy coating . . . formulation for tooling and developmental work eliminates need for waiting for tack stage. Laminating with glass cloth may be started immediately after application. Can be brushed on paper thin or built up to ⅛ in. Will hold glass cloth away from layup surface at any selected thickness for other applications. Jell time is 18 to 22 min. Ren Plastics Inc, 5422 S Cedar Rd, Lansing 9, Mich.

Circle 113 on Reader Service Card

MOLDED FIBER GLASS

makes the revolutionary new

White "5000" Cab

It's a radical new design, possible only with MOLDED FIBER GLASS . . . it is thirty-six MOLDED FIBER GLASS parts, bonded into an integral unit . . . space saving, efficient, lightweight, profit-earning.

This MOLDED FIBER GLASS cab is warm in winter, cool in summer, quiet . . . rust-proof, impervious to salt and road chemicals . . . tough, impact-resistant.

Write or phone today for cost estimates on making *your* products better with MOLDED FIBER GLASS, as matched-metal-die-molded by the world's largest, most experienced producers of fiberglass reinforced plastic.

Molded Fiber Glass Body Company

GREATEST NAME IN REINFORCED PLASTICS — MOLDED FIBER GLASS

4623 Benefit Avenue, Ashtabula, Ohio

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

Speed production bonding with this 1-part "no-mix" paste epoxy

TECHNICAL DATA ON

Bond*master*® M620

A thixotropic, heat-curing (300°F or higher), 100%-reactive, *one-part* ("no-mix"), solvent-free formulated epoxy adhesive designed for bonding metals and rigid plastics as well as other rigid materials to themselves and to each other.

APPLICATION

BONDMASTER M620 is soft and buttery, making it extremely easy to spread smoothly and evenly right from the container in which you receive it. Once applied, it maintains its form and DOES NOT FLOW during the curing cycle. Excellent for "poor fit" and similar void-filling applications as well as where dripping or running of adhesive cannot be tolerated.

BOND CHARACTERISTICS

Fully-cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

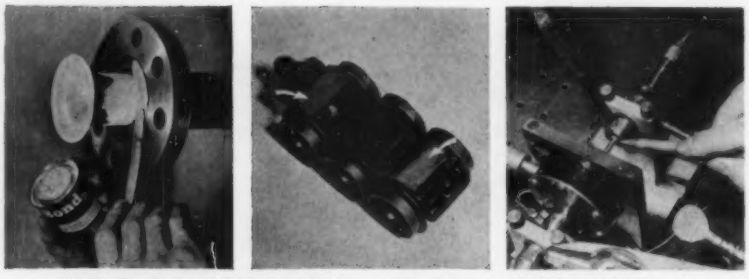
ALL METALS—ALMOST ALL PLASTICS

Current production usage of this formulation includes bonding: "Teflon" to steel, aluminum and other metals; phenolic to aluminum; diamonds to graphite; ceramic to steel; glass to brass; Alnico to aluminum and cast iron; carbide to steel; "Mycalex" to itself; aluminum to itself, to copper, steel, zinc die cast, magnesium, etc.; reinforced polyester fiberglas to itself and to various metals; stainless steel to bronze; rigid plastics to themselves and to various metals.

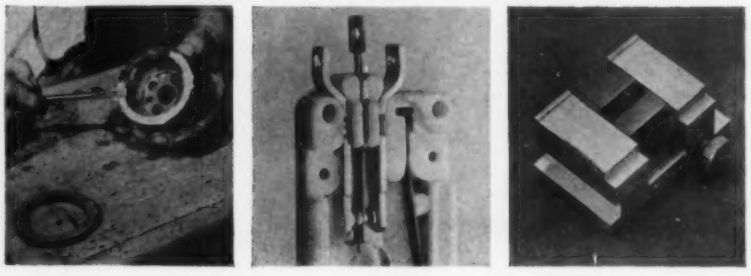
R&A SINCE 1913

RUBBER & ASBESTOS CORPORATION

235 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY



"Teflon" to steel . . . Alnico to zinc die cast . . . glass to brass . . . carbide to stainless . . . rigid plastic to copper . . . ceramic . . . stainless . . . cast iron . . . magnesium . . .



If the materials you work with can be heat-cured in the 300°F range (or higher), here's an unusual development in 100%-solids epoxy adhesives—BONDMASTER M620 — a unique *1-part* paste that can:

- give you high shear strength bonds between all metals and just about any plastics
- eliminate costly post-finishing (this paste won't flow or drip during cure!)
- permit the use of relatively unskilled labor on critical metal and plastics bonding jobs
- eliminate time-consuming weighing and mixing of separate components

—at a fraction of the cost-per-pound normally applying to 100%-reactive, heat-curing formulated epoxy adhesives.

NO MIXING

You can use this versatile formulation right from the can, just as you receive it. It not only spreads as easily as a heavy cold cream, but it's thixotropic, too . . . won't flow or drip during the cure, won't sag in *any* position.

MULTI-PURPOSE USE

Because BONDMASTER M620 offers outstanding speed and savings in the mass production bonding of a wide range of similar and dissimilar materials (see list in column on left), it is supplanting silver solder in some of the leading metalworking plants in America.

Write for Technical Data Sheet. (We will be glad to send a free evaluation sample as well if you will describe your bonding problem in detail.)

INDEX TO ADVERTISERS

This index is published as a convenience to the readers. Every care is taken to make it accurate but PRODUCT ENGINEERING assumes no responsibility for errors or omissions.

AMP, Inc. 29
Albion Industries, Inc. 39

Corning Glass Works. 5

Emerson Electric Mfg. Co. .....4th Cover

Hyatt Bearing Div., General Motors Corp. 21-25

Kaupp & Sons, C. B. 27
Keystone Carbon Co. 6
Koppers Co., Inc., Plastics Div. 20

Minneapolis-Honeywell Regulator Co., Industrial Div. 8
Molded Fiber Glass Co. 39

National Seal Div., Federal-Mogul-Bower Bearings, Inc. .....3rd Cover

Production Instrument Div., General Controls Co. 38

Rubber & Asbestos Corp. 40

United States Steel Corp. 14-17, 36

Veeder-Root, Inc. 18

Westinghouse Air Brake Co., Industrial Products Div. 28
Wiegand Co., Edwin L. 10
Worthington Corp. .....2nd Cover

PRODUCT ENGINEERING ADVERTISING SALES STAFF

Atlanta 3 . . . W. O. Crank, 1301 Rhodes-Haverty Bldg., Jackson 3-6951

Boston 16 . . . M. A. Williamson, Jr., 350 Park Square Bldg., Hubbard 2-7160

Chicago 11 . . . Mid-Western Adv. Sales Manager, A. E. Meanor; R. W. Bruley, L. Anderson, 520 N. Michigan Ave., Mohawk 4-5800

Cleveland 13 . . . A. F. Tischer, 1164 Illuminating Bldg., 55 Public Square, Superior 1-7000

Dallas 1 . . . R. T. Wood, 901 Vaughn Bldg., 1712 Commerce St., Riverside 7-5117

Denver 2 . . . John W. Patten, 1740 Broadway, Mile High Center, Alpine 5-2981

Detroit 26 . . . P. B. Robinson, 856 Penobscot Bldg., Woodward 2-1793

Los Angeles 17 . . . Robert Obenour, 1125 West 6th St., Madison 6-9351

New York 36 . . . B. K. Adams, F. J. McKinley, 500 Fifth Ave., Oxford 5-5959

Philadelphia 3 . . . D. G. Jones, K. S. Willadson, 6 Penn Center Plaza, Locust 8-4330

Pittsburgh 22 . . . C. F. Leveroni 1111 Oliver Bldg., Express 1-1314

St. Louis 8 . . . R. W. Bruley, 3615 Olive St., Continental Bldg., Jefferson 5-4867

San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

NEW LITERATURE

The Moon Car

HERMANN OBERTH. Harper & Brothers, 49 E 33rd St, New York 16. 5½ x 11, 98 pp. $2.95

The author here sets himself the task of designing a means of transportation for the first moon explorers. The problems are many; Mr Oberth sees the first as expense, and estimates that "the cost of the moon car—even if it should be $100,000—would be a minor item . . ." We would guess Mr Oberth's design can't be made for less than $1 million.

The second problem is the lack of atmosphere. This means the cab must be totally enclosed and pressurized for human occupation and, equally important, the primary power source will need to carry its own oxidizer since the moon car is to be IC-engine powered, with an assist from a "solar energy plant." The oxidizer, incidentally, is hydrogen peroxide; the fuel, gasoline.

Cooling is also a problem (over 5 pages of "Stephan-Boltzmann" equations), as are the washing and toilet facilities (Mr Oberth tries to think of everything), food, and the ionized state of the very slight lunar atmosphere.

Next comes gravitation—⅙ that of earth's. Mr Oberth estimates his moon car as 10 metric tons (about 22,000 lb) on earth, which reduces to 3640 lb on the moon—a figure that tempts him into strange byways. He foresees serious problems in getting across chasms and other deep breaks in the moon surface. The solution? Why, just jump across. No kidding, he has designed a single-legged vehicle maintained in balance by a gyro. The leg has a pair of caterpillar treads at the foot for normal running, but occasionally the driver will want to jump. The single leg is a telescoping affair. High-pressure air is piped into the upper section and off you go—over 400 ft up if you like.

This pogo-sticking around the moon should become a favorite pastime of explorers.

Mr Oberth gives another 50 pages of detailed specifications for his moon car—the control circuits, the design of cabin appointments, the external structure, a crane, a collecting mirror servoed to follow the sun. In addition to the gyro, there's a "severely dampened" pendulum, several dozen electric motors of various power ratings, and at least one generator that "must produce as much as 2000 hp, if only for a short time."

It's a pity the book can't be taken seriously. The moon car is a fascinating challenge to the creative imagination and one well worth the attention of able engineers. As it is, this book will probably only be read (and aptly so) by Lunatics like me. —RMK

FACILITIES FOR MECHANISM TESTING – Book, 57 pp. Covers function, scope and services of organization that specializes in theoretical and experimental stress analysis testing and design. Includes representative projects. Brewer Engineering Laboratories Inc, Marion, Mass.

Circle 140 on Reader Service Card

ENGINEERED RUBBER FACILITIES –Brochure, 24 pp. Discusses personnel and facilities for determining proper rubber compound for specific applications and for most economical method of manufacture. Covers molded rubber parts, bonding rubber to metal, vibration mounts, O-rings and gaskets, and diaphragms. Stoner Rubber Co Inc, 10792 Knott Ave, Anaheim, Calif.

Circle 141 on Reader Service Card

RESEARCH AND TESTING–Brochure, 4 pp. Describes capabilities and facilities for research and testing in aerodynamics and meteorology. Evaluation Unlimited Inc, Dept PE, 520 Fifth Ave, New York City.

Circle 142 on Reader Service Card

How hard do you have to work to make good luck "just happen"?

Parm Pritchard was just promoted. New production boss. "I just got the breaks," he says.

Don't you believe it! He worked at it from the day he discovered his McGraw-Hill publication. All about *his* job, *his* interests, *his* future. He read it avidly.

Parm had his eye on management. Management had its eye on him. And when a man's interests, and a company's interests come this close together, something good is bound to happen. And did!

As a reader of this specialized McGraw-Hill publication, tap its resources deeply. And after you've really dog-eared this issue... please pass it on to the man you'd like to have get your job, when you're promoted. Open it to this page . . .

Men who read more...earn more!

EMPLOYMENT OPPORTUNITY

SPECIFICATIONS WRITER

BUTLER MANUFACTURING COMPANY, MULTI-PLANT WORLD LEADER in manufacture and sales of a broad line of pre-engineered buildings and other durable capital equipment is seeking capable Specifications Writer to prepare material specifications for metals, plastics and components used in the manufacture of pre-engineered buildings. Employment in headquarters Engineering Department of Buildings Division.

College training in Chemical, Mechanical or Civil Engineering preferred. Experience in and familiarity with ASTM and Commercial Standards and Federal Specifications desirable. Considerable knowledge of metallurgy and metals needed.

Salary in line with experience and ability. Advancement by merit. Residence in corporate headquarters city, Kansas City, Missouri. Progressive and liberal compensation and benefit plans.

Send full information on personal and work history to Mr. Orval W. Groves, Employment Supervisor, 7400 East 13th Street, Kansas City 26, Missouri.

BUTLER MANUFACTURING COMPANY

PROFESSIONAL SERVICE

RELIABILITY EVALUATION AND IMPROVEMENT

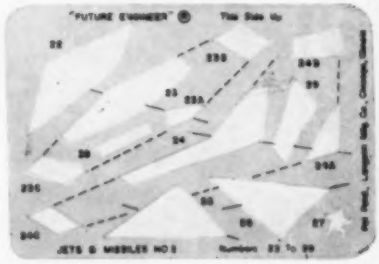
• Practical applications of advanced techniques in Statistical Methods for Engineering, Research and Development and Manufacturing

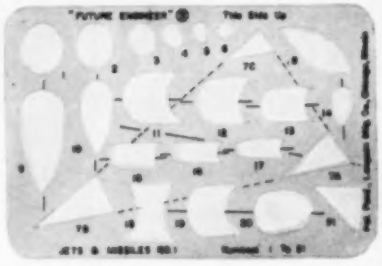
RATH & STRONG, INC.
Industrial Consultants
140 Federal St., Boston 10, Mass.
Liberty 2-6658

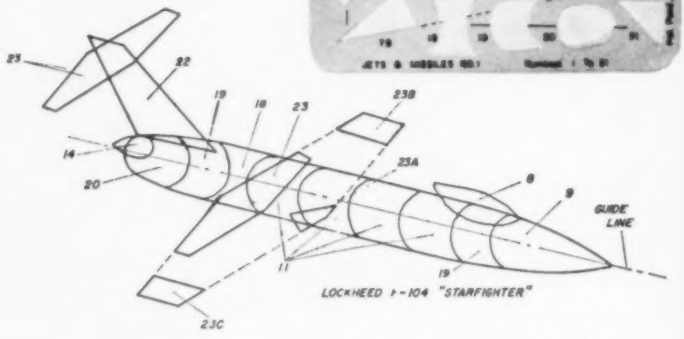
For Your Information (personal)

Drawing in the Jet Age

Let him design his own jets, says Design-Ette Inc, 940 South Fifth St, Princeton, Ill. It offers this templet set to help the future engineer do the job. Two plates, 4 x 6 in., have outlines for wing, tail, and fuselage sections, engine cowlings and nosecones; make it possible to draw "standard" planes as well as design new ones. Price: $1 a set plus 25¢ handling charge.







You can even make your own tires

A "do-it-yourself" tire, invented in Italy, is now being marketed here. It's a casing with provision for three tread bands which can be removed and replaced as desired—without tools.

In summer, on smooth roads, use the standard tread. For rough going, try a heavier one. In winter, insert carbide steel spikes to prevent slipping on ice. And when one section is worn, just replace it—and leave the others on. What holds the rings in place? Expansion. They're slightly smaller than the casing in diameter and are set in place while the casing is deflated. Then, when the casing expands, they're secured "so firmly they cannot move even when the car is braking or cornering." Pirelli of Italy is making them, and will market them here "in a few months." —ARG

Why Don't They RESEARCH and DEVELOP . . .

. . . equipment for the blind, deaf, palsied, and persons who have lost the use of one or more limbs. Communication is their biggest problem. Anyone who has seen a blind person struggling with a simple problem in long division or witnessed the painfully slow motions of a palsied hand attempting to write a letter, appreciates that a need exists. Although the market for such equipment is comparatively small, the possibilities are great. Most of the equipment presently available is relatively crude—frequently just haywired together to meet the immediate needs of one handicapped person. For example, newspapers last week carried the story of a boy who is unable to speak or move arms and legs. To allow him to write, a technician rigged up an electric typewriter with keys the size of silver dollars so that the boy could punch out a message with a stylus strapped to his forehead.

Some recent developments indicate that some progress is being made. Earlier this year, IBM announced a machine that translates English text, via punched card, into a Braille printing plate. Equipment of this kind could eliminate manual translation methods, replace the 5000 people who now do Braille typing. Battelle Memorial Institute, in cooperation with the Veterans Administration, has in development an electronic device that scans a line of printed characters and converts it into an audible code somewhat like Morse. It is reported that speed is reasonably good and the equipment requires relatively little practice. The new field of bioelectronics (see p 9, this issue) may have promise of amputees and others who have lost the use of limbs.—F DEPEW

. . . a humidity-sensitive shut-off switch for home clothes dryers to avoid having them run longer than necessary. Such a device would simply compare humidity of incoming air with exhaust air and control accordingly.—J WALLINGER

. . . an electromechanical clock for home and industrial applications that operates on a principle similar to that of an automobile clock. House current would supply power to the conventional synchronous induction motor plus enough additional power to keep the spring wound. Normally, the clock would operate synchronously (and thus, accurately) but when power failed the spring would come into action. Would be particularly useful for critical industrial applications, control of gas- and oil-fired furnaces, timers, alarm systems, standby equipment, test apparatus.—H TURENCHALK

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PROJECT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for necessary R & D. We will pay $10 for each one accepted.

PLEASE TYPE OR PRINT

Name .....

Title ..... Dept. .....

Company .....

Address .....

City..... Zone.... State.....11/30/59

PRODUCTS ADVERTISED

1	8	15	22	29	36	43	50	57	64	71	78	85	92	99
2	9	16	23	30	37	44	51	58	65	72	79	86	93	100
3	10	17	24	31	38	45	52	59	66	73	80	87	94	
4	11	18	25	32	39	46	53	60	67	74	81	88	95	
5	12	19	26	33	40	47	54	61	68	75	82	89	96	
6	13	20	27	34	41	48	55	62	69	76	83	90	97	
7	14	21	28	35	42	49	56	63	70	77	84	91	98	

SIGNIFICANT PARTS and NEW LITERATURE

101	106	111	116	121	126	131	136	141	146
102	107	112	117	122	127	132	137	142	147
103	108	113	118	123	128	133	138	143	148
104	109	114	119	124	129	134	139	144	149
105	110	115	120	125	130	135	140	145	150

SPECIAL DATA: P23 _____

☐ *Enter my 1-year subscription to PRODUCT ENGINEERING. I will receive 52 weekly issues plus the annual Design Digest Issue. (Domestic—$5 for one year.)*

★ *If you want to be sure of seeing every issue of Product Engineering—52 regular issues plus the annual Design Digest—enter your subscription on the attached information card. Only $5 for one year.*

PLEASE TYPE OR PRINT

Name .....

Title ..... Dept. .....

Company .....

Address .....

City..... Zone.... State.....11/30/59

PRODUCTS ADVERTISED

1	8	15	22	29	36	43	50	57	64	71	78	85	92	99
2	9	16	23	30	37	44	51	58	65	72	79	86	93	100
3	10	17	24	31	38	45	52	59	66	73	80	87	94	
4	11	18	25	32	39	46	53	60	67	74	81	88	95	
5	12	19	26	33	40	47	54	61	68	75	82	89	96	
6	13	20	27	34	41	48	55	62	69	76	83	90	97	
7	14	21	28	35	42	49	56	63	70	77	84	91	98	

SIGNIFICANT PARTS and NEW LITERATURE

101	106	111	116	121	126	131	136	141	146
102	107	112	117	122	127	132	137	142	147
103	108	113	118	123	128	133	138	143	148
104	109	114	119	124	129	134	139	144	149
105	110	115	120	125	130	135	140	145	150

SPECIAL DATA: P23 _____

☐ *Enter my 1-year subscription to PRODUCT ENGINEERING. I will receive 52 weekly issues plus the annual Design Digest Issue. (Domestic—$5 for one year.)*

Publisher's Postscript...

EDITORIAL BLUSHES

"How is business?" one Hollywood magnate was reported to have asked another. "Stupendous, magnificent, colossal . . . but it will get better", is the reported reply.

This illustrates the American tendency to exaggeration. Two bombers in World War II reportedly "blasted" a major German city. Every invention is, at least in the inventor's opinion, the "greatest since the wheel." Our failures at Canaveral were magnified out of all proportions–as were the Russian successes. The reputed Texan characteristic of talking big is actually a national one.

In the face of this, I confess I am at times perplexed by the tendency of our editors to play down their successes. They fail to mention the record-breaking (at least in our shop–I must not be guilty of exaggeration) response for copies of certain of their articles, the greatly increased number of complimentary letters they receive, the acceptance in the field for their frankly expressed points of view on Russia, patents, invention, engineering education. They have been called "engineers' engineers" and "editors' editors," whatever that may mean.

What I'm trying to say is perhaps best illustrated by our letters column. The editors select for extraction there those letters which add something to the previous discussion, or bring out a new point. Letters critical of the editorial point of view or correcting an error they rush into print. But the many more letters that compliment them on a job well done, or ask for permission to reprint, or the like, they do not print.

This policy seems to me to be one-sided, but they insist that publishing complimentary letters would be mere bragging, and would be so interpreted by you. I can see that a letter from someone whose product has been described, or whose article has been published, or whose speech has been faultlessly reported, might be considered as having a favorable bias, but what of the others, from subscribers and other readers? The editors are happy to have a steady flow of them. But publish them? No!

Take for example a recent letter from an engineer about our "Horizons" page: "I like to believe that your column is a factual record of your thinking and is expressed without regard to criticism, prejudice or coercion. It would seem that this must be true as I find your articles somewhat different in that they aren't the run-of-the-mill nothings written by others . . . I am a voluminous reader of various subjects from earthworms to astronauts . . . save various articles that seem sound and tend to prove a point. This collection has grown to a sizable amount and I endeavored to reorganize it for better reference. I was amazed at the number of pages I had . . . of your Horizon articles . . . Your articles show logic, wit, advanced thinking, and enough individual originality to be outstanding . . ."

That one put our editor on Cloud 9 for the day. But publish it? That would be bragging, he thinks. I don't–but then I've always been sales and promotion minded, and when you're selling something in America you must learn not to blush at a compliment. –SJA

Issue of November 30, 1959
Product Engineering
Card Expires January 29, 1960

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

Postage Will Be Paid By Reader Service Department

PRODUCT ENGINEERING
330 WEST 42ND STREET
NEW YORK 36, N. Y.

★ *If you want to be sure of seeing every issue of Product Engineering—52 regular issues plus the annual Design Digest—enter your subscription on the attached information card. Only $5 for one year.*

Issue of November 30, 1959
Product Engineering
Card Expires January 29, 1960

FIRST CLASS
PERMIT No. 64
NEW YORK, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

Postage Will Be Paid By Reader Service Department

PRODUCT ENGINEERING
330 WEST 42ND STREET
NEW YORK 36, N. Y.

NATIONAL OIL SEAL LOGBOOK

Announcing!

NATIONAL UNITSEAL
(TRADEMARK)

Flanges, if desired, are available to simplify positioning and removal

National UNITSEAL has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National UNITSEAL is now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer UNITSEALS are on the way for higher speed automotive and similar uses.

Changing a National UNITSEAL automatically changes the wear sleeve — in one fast operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem—both thanks to the rubber surface UNITSEAL presents to the shaft.

Get complete details today; write direct, or call your National Seal Applications Engineer. He's in the Yellow Pages, under Oil Seals.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

6013

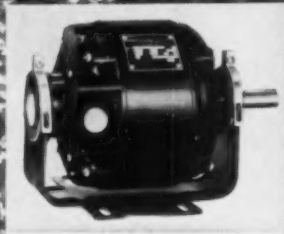
CIRCLE 77 ON READER SERVICE CARD

Here Experience Counts

Sure, sometimes luck helps out a fisherman . . . but in the long run it is experience that pays off. And it is experience that pays off when it comes to solving power-drive problems for appliance and equipment manufacturers . . . the kind of experience Emerson-Electric offers *you*.

Remember . . .

- Emerson-Electric produces *custom-engineered* motors to suit *your specific needs*.
- Emerson-Electric has more than 100 engineers for on-the-spot service for *you*.
- Emerson-Electric has more than 65 years' experience in solving motor-drive problems *like yours*.



To get the kind of experience that counts, call, wire or write Dept. EE-35 today. The Emerson Electric Mfg. Co., St. Louis 21, Mo.

EMERSON-ELECTRIC *of St. Louis · Since 1890*

CIRCLE 78 ON READER SERVICE CARD